British Columbia
Centre of Excellence
for Women's Health

Centre d'excellence de la
Columbie-Britannique
pour la santé des femmes

The Health Benefits of Physical Activity for Girls and Women

Literature Review and Recommendations for Future Research and Policy

Co-Editors

Colleen Reid
Lesley Dyck
Heather McKay
and Wendy Frisby

British Columbia
Centre of Excellence
for Women's Health
Vancouver, BC CANADA

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Main Office
E311 - 4500 Oak Street
Vancouver, British Columbia
V6H 3N1 Canada
Tel 604.875.2633
Fax 604.875.3716
Email bccewh@bccewh.bc.ca
Web www.bccewh.bc.ca

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Colleen Reid

Project Coordinator

PUTTING IT INTO PERSPECTIVE

December 1999

The Canadian Association for Women and Sport and Physical Activity (CAAWS) is delighted to be a partner in the production of “The Health Benefits of Physical Activity for Girls and Women”. This publication represents a new and exciting approach to understanding the relationship between the health of girls and women and physical activity.

Evidence is mounting that recreational sport and physical activity are positive elements in the lifestyles, not only of healthy women, but equally so of women who are coping with many forms of diseases including breast cancer, heart disease and osteoporosis. The activity can take many forms, from the joyous exertions of dragon boat racing, to an Osteo-Fit class, to the quiet pleasures of gardening, to fun-filled family outings.

CAAWS strongly supports sport and physical activity as part of an overall healthy lifestyle. This is why we have been forging links and establishing partnerships with Canada’s health community.

Health delivery agencies now agree that recreational sport and physical activity are important components of the lifestyles of girls and women. At the same time there is growing awareness of gender-specific health issues and the need to program specifically for gender. Rising health care costs have health care practitioners looking for programming choices that will reduce expenditures without impairing health delivery. Physical activity more than fits the bill.

The interdisciplinary approach of “The Health Benefits of Physical Activity for Girls and Women” provides great insights about the health-sport connection. This foundational document will serve us well in our ongoing efforts to encourage girls and women to pursue a healthy lifestyle that includes physical activity.

Bryna Kopelow

Chair, Canadian Association for the Advancement
of Women and Sport and Physical Activity
www.caaws.ca
caaws@caaws.ca
1600 James Naismith Drive
Gloucester, Ontario
K1B 5N4
ph (613)748-5793
fax (613)748-5775

EXECUTIVE SUMMARY

The project

There are many positive health benefits associated with regular physical activity, and the health risks of inactivity are equally clear. Most of the research on physical activity, however, has been contained within the sport, exercise and recreation disciplines. Studies on the implications of physical activity for disease prevention, management and rehabilitation are increasing but are still limited in number and scope. As well, the relationship between physical activity and the well-being of individuals and communities has not been adequately understood, and the linkages between disease, social and psychological well-being, and physical activity need to be explored more fully. Finally, it has been argued by feminist researchers that the biological, psychological, social and cultural experience of being female in our society has not been adequately addressed in much of the health and exercise literature.

This literature review originated from the difficulties policy makers, practitioners, and programmers experienced in accessing diverse sources of research, and the challenges they faced while attempting to make sense of conflicting conclusions. Notwithstanding, the current health and well-being trends in the Canadian population provided an additional imperative for this project. Girls are less active than boys at most ages, women have been experiencing increasing rates of various diseases such as fibromyalgia, coronary heart disease and cancers, and both girls and women experience body image dissatisfaction, low self-esteem and eating disorders at a much higher rate than boys and men. This literature review tackled the complex relationship between health and physical activity in the context of girls and women's lives through a multi-disciplinary and holistic approach. From this analysis, future research strategies and policy implications to support and improve the health and well-being of girls and women were identified.

Summary

This review of current research brought together a multi-disciplinary team of 12 researchers affiliated with the University of British Columbia, and an advisory committee with representation from non-governmental health and advocacy organizations concerned with the physical activity and health of girls and women. While this literature review is specifically concerned with the health of women and girls, the programs and policies related to physical activity are generally outside of the formal health care system.

This research project was conceived as a starting point to accumulate the relevant information regarding the health benefits and risks of physical activity for girls and women. The health concerns included for review were limited by the research team and steering committee to ensure the scope of the project was manageable with respect to the time and resources available. The following health concerns were included. They are not meant to be exhaustive, but were chosen based on their prevalence and importance to the health of girls and women:

- psychosocial health and well-being (including stress, anxiety, depression, premenstrual syndrome, self-efficacy, mood state, cognitive functioning, well-being and quality of life)
- body image and self-esteem
- eating disorders
- smoking cessation and drug rehabilitation
- cardiovascular disease and hypertension
- osteoporosis
- estrogen-related cancers
- menopausal symptoms
- fibromyalgia and chronic fatigue syndrome

Specific attention was also paid to the place of marginalized women within the research. This was supported by the inclusion of the following diversity key words and related issues in the literature search and analysis:

- age/lifecycle
- race/ethnicity
- disability/ability
- sexual orientation
- socioeconomic status

Finally, physical activity was not limited to the traditional and more common conceptions of exercise and fitness, but also included recreation, sport, leisure and active living.

Research recommendations

There are some common threads that can be followed through the recommendations for future research and the implications for practice and policy. In general, the beneficial effects of regular physical activity are supported for positive health in each of the health issues addressed in this review. For cardio-pulmonary fitness and bone density this relationship has been strongly supported. In fact, for the prevention of estrogen-related cancers, it has been demonstrated that physical activity can act as a manipulable "lever". Exercise programs should be started early in life and maintained through adulthood, and women of all ages should be encouraged to increase their relative levels of participation in physical activity. It was found that physical activity also plays important roles in the promotion of health, the prevention of disease conditions, the rehabilitation from disease, and the management of other risk factors.

This study also identified a number of limitations in the current state of the literature. Much of the research that has been done in areas such as addictions, cardiovascular disease and hypertension has been based on men. The research that has been done on women in all of the health areas under consideration has not adequately conceptualized or considered women's diversity (age, ethnicity, sexual orientation, disability and socioeconomic status). Most areas could benefit by the use of more long-term and qualitative research, while others require large-scale, randomized interventions and other quantitative strategies in order to strengthen our understanding of the relationship between physical activity and health and well-being. In addition, the effects of physical activity could be more easily understood and evaluated through the development of techniques to evaluate physical activity in the context of daily life rather than strictly as components of fitness and exercise. Finally, physical injury as a result of over-exercising is a potential concern, and the research on body image and eating disorders indicates that physical activity itself may be a risk factor for some women.

Practical and policy implications

These general research recommendations clearly illustrate the need for policy makers and programmers to support not only more opportunities for women to participate in physical activity, but to seriously consider the quality of these opportunities. Programs, facilities and environments need to be tailored for distinct populations of girls and women. Research has demonstrated that groups defined by gender, age, activity levels (active, sedentary), socioeconomic status, and ethnicity have different needs and capacities and are therefore best supported using different strategies.

There is also an opportunity to consider policy changes from both a broad social-environmental and a more narrow disease-prevention perspective. For instance, those developing both health and recreation policy must consider the interrelationship between active women's unhealthy relationship with food, their diminished power within a male-dominated society (and sports world), and cultural standards of female beauty that emphasize an ultra-thin physique. Women in midlife need to feel confident that regular physical activity is an achievable and unselfish goal, one that is sanctioned by the health profession and society as a whole, and one that will be of benefit to their health and self-image. Just as leaders in the fitness industry need to make health and the prevention of disordered eating a priority, it is also important for practitioners and those working in the community to make physical activity an integral part of the prevention and treatment of diseases such as coronary heart disease and hypertension.

Due to the many ways physical activity affects physical, personal, and social well-being, the meaningful development of policies and programs to support the health and well-being of girls and women through physical activity will require a multi-dimensional strategy. The promotion and support of increased physical activity is an excellent tool for the development of community partnerships and collaborations. Physical activity has the capacity to be an organizing principle for practitioners, policy makers and activists in health care, recreation, fitness, sport, and social work, and to help build healthy communities that improve our individual and collective quality of life.

INTRODUCTION

Colleen Reid, M.A. & Lesley Dyck, M.A.

As we look back on the past century, a great deal of progress can be observed in support of health and well-being for girls and women in the Western world. Childbirth is no longer as hazardous for the mother or the child, life expectancies have increased significantly, and quality of life, measured as manual labour, consumer goods, and leisure time, has also improved. We have also made great strides in the area of gender equity. Women are moving into professions traditionally dominated by men, experiencing greater acceptance of diversity and alternative lifestyles, and participating more fully in the community in everything from politics to sports. Despite these advances, women on average earn 70 cents for every dollar earned by men, struggle with a double burden of paid employment and unpaid work in the home, are most often the primary caregivers to children and aging adults, face unattainable standards for body image, and continue to be subject to domestic violence.

This does not, of course, mean that all women are worse off in every way than all men. But it remains true that in most societies the male is valued more highly than the female. Men are usually dominant in the allocation of scarce resources, and this structured inequality has a major impact on women's health [1; p. 1].

It is within this context that programmers, policy makers and advocates have worked to improve the health and well-being of girls and women. Recognition of the complexity of the dimensions of well-being and the determinants of health has led to the development of a range of theoretical models and practical strategies in the support of health and well-being. Unfortunately, it appears that much of this work has been accomplished in disciplines such as medicine, epidemiology, physiotherapy, nutrition, exercise science, athletics, social work and social planning, and independent of one another. There has been a serious lack of consideration of the potential for these areas to complement and strengthen each other. However, as understandings of health broaden to include emotional, social, cultural, and spiritual well-being, significant improvements in health and well-being will require a multi-disciplinary approach. The body shows physical symptoms of disease, but also carries cultural meaning through body image and appearance. In this way, multi-disciplinary work builds on the strengths of, and creates linkages between and among, theoretical disciplines and individual practitioners. The study of physical activity from a variety of perspectives provides a powerful opportunity to support the well-being of girls and women in a holistic and fundamental way. This is the starting point for the development of a richer understanding of the links between physical activity and the health and well-being of girls and women.

A. Project Purpose and Limitations

The Health Benefits of Physical Activity for Girls and Women presents an interdisciplinary portrayal of what is known about the benefits and risks of physical activity and inactivity for the health status of girls and women. When viewed collectively, the research findings discussed here emphasize the importance of considering the strength of the relationship between the various types and contexts of physical activity, and health status, with respect to the diversity of women and girls. The intention of this research project is to provide a starting point to support further research and the development of public policy by:

- accumulating and systematically reviewing the relevant literature
- critically analysing and identifying gaps in the knowledge
- prioritizing research questions for future study and identifying promising research methods
- providing the foundation for a discussion of the implications for policy and practice

By systematically reviewing the literature on the relationship between physical activity and the most prevalent health concerns affecting North American women today, this research project provides an overview of the research designs that are currently used to study the benefits of physical activity for girls and women. As a result, this report is able to identify the key disciplines and researchers that have been involved in advancing knowledge in this area. The multidisciplinary nature of this project also makes it

possible to uncover areas that have been largely neglected in the study of the relationship between physical activity and health. These areas of neglect include subjects such as the diversity of girls and women in North American society, alternatives to the dominant male model and understanding of sport, and a more holistic understanding of the context in which disease occurs.

The ultimate objective of this report is to stimulate the development of effective and efficient policies and programs that support the health and well-being of girls and women in every community in Canada. This review provides a starting point for meeting this long-term objective by:

- contributing to our understanding of physical activity as a determinant of health
- valuing the importance of social context and lived experience in order to understand the relationship between physical activity and health status for women and girls in our society
- facilitating the process of transforming research information into knowledge and policy in order to increase the participation of women and girls in physical activity
- developing links between social, health and recreation policy makers, as well as researchers and practitioners from various disciplines concerned with the well-being of women and girls

Health areas reviewed

This research project was conceived as a starting point to accumulate the relevant information regarding the health benefits and risks of physical activity for girls and women. The following health concerns were chosen to limit the literature to the most important ones based on their prevalence and importance. These health concerns include:

- Psychosocial well-being (including stress, anxiety, depression, premenstrual syndrome, self-efficacy, mood state, cognitive functioning, well-being and quality of life)
- Body image and self-esteem
- Eating disorders
- Smoking cessation
- Cardiovascular disease
- Osteoporosis prevention
- Estrogen-related cancers
- Menopausal symptoms
- Fibromyalgia and chronic fatigue syndrome

Limitations

The health concerns selected for inclusion are not meant to be exhaustive of all health concerns relevant to girls and women, but were chosen to limit the literature to the more important issues based on their prevalence and salience in the lives of women. For example, although topics such as nutrition/eating habits, amennorhea, mental illness, reproduction, diabetes, social relationships, discrimination, social support/isolation, community safety, and violence/abuse have been identified as important areas for consideration, they are not included due to limited time and financial resources.

Readers should also consider the findings of this project in the context of the daily lives of women and girls. Understanding the benefits and risks of physical activity is only one piece of the puzzle regarding “why, when, where and how” to support positive participation for females throughout the lifecycle. Any health promotion strategy must also consider the impact of physical activity and inactivity on health status in light of what is known about the determinants of physical activity and the influence existing policies and community programs have had on the health and well-being of girls and women.

B. The Need for a Multi-disciplinary and Gender-specific Approach

The need for more complete and gender-specific information became an issue for advocates of physical activity in British Columbia when they were attempting to argue the importance of physical activity to the

health and well-being of girls and women. They found that even though there are many positive health benefits associated with regular physical activity, and that the health risks of inactivity are equally clear, most of the research on physical activity has been contained within the sport, exercise and recreation disciplines. Studies on the implications of physical activity for disease prevention, management and rehabilitation are increasing but are still limited in number and scope. The relationship between physical activity and the well-being of individuals and communities has not been adequately understood, and the linkages between disease, social and psychological well-being, and physical activity need to be explored more fully. As many feminist researchers have pointed out, the biological, psychological, social and cultural experience, and diversity, of being female in our society has not been adequately addressed in much of the health and exercise literature.

This literature review originated from the frustration and confusion of policy makers, advocates and programmers who are working in this research and information environment. They typically face difficulties in locating relevant research and often find research conclusions contradictory and misleading. As well, the current funding environment of cutbacks and downsizing for social, education, and health programs contributes to the importance of this report. The lack of resources makes it imperative for government and non-governmental organizations (NGO's) alike to use the resources they do have more efficiently and effectively. This often means struggling to provide an adequate level of service by doing more with less, developing partnerships in new and different ways, and emphasizing injury prevention and health promotion strategies in an effort to keep individuals out of the more costly health care system. By elucidating the relationship between physical activity and health status for girls and women, identifying promising research strategies, and making links between the research and the policy and program issues, this review will help to support the development of effective and timely health promotion strategies that make efficient use of available resources. The multi-disciplinary nature of this report also underscores the potential for community-based partnerships between diverse organizations to support the health and well-being of girls and women.

Beyond the resource crisis in the health-care system, current health and demographic trends for girls and women in the Canadian population provide an additional imperative for this project. Our population is aging, and women have been experiencing an increase in rates of various diseases such as fibromyalgia, coronary heart disease and cancers. Meanwhile, girls are less active than boys at most ages, and both girls and women experience body image dissatisfaction, low self-esteem and eating disorders at a much higher rate than boys and men. Once again, in order to recognize and clarify the complexity of the relationship between health and physical activity in the context of girls' and women's lives it is important to approach these issues in a multi-disciplinary and holistic way.

The idea of interdisciplinary research has received support in the health promotion and physical activity literature. All too often a false dichotomy is created between qualitative and quantitative research, reducing the complexities of research approaches to simple and rigid polarities [2]. Traditionally we have been crippled by a continued fixation upon what is strong about one approach and weak about another. This research project recognizes that there are different and complementary ways of understanding the links between physical activity and health for girls and women, and validates the ways different kinds of knowledge contribute to our understanding of this complex and multi-faceted issue.

The possibilities and potential for interdisciplinary research to contribute to our knowledge can be seen in the linkage between some of the most prevalent health issues facing women and girls today. For example, research has demonstrated that 10 times more women than men experience eating disorders, and almost three times as many females as males use smoking as a way to control their weight and to stay slim. Eating disorders are usually a reflection of low self-esteem, poor body image and feelings of a lack of control over one's life [3]. If a girl or a woman maintains an unhealthy low body weight through restricted caloric intake or by suppressing her appetite by smoking, she is then at a far greater risk than the average woman for poor bone mineral density and osteoporosis. Although the prevalence of osteoporosis is increasing among women undergoing the inevitable postmenopausal decrease in estrogen production, a woman who has struggled with an eating disorder may experience it more acutely and possibly at a younger age. As well, coronary heart disease is the leading cause of death for older women, and indisputably there is a connection between coronary heart disease and smoking tobacco. Therefore a

woman who smokes as a means to control her weight is more highly predisposed to coronary heart disease than a woman who has a healthy body image and does not smoke.

What emerges from an analysis such as this is that osteoporosis and heart disease are linked to body image and self-esteem. This is not the typical way of looking at these health issues, but it provides a very compelling argument for tackling issues of body image in order to prevent these diseases. As a result, physical activity becomes an important intervention because it physiologically contributes to bone and heart health, and because it psychosocially contributes to a positive sense of self through the development of positive body image and esteem. Undoubtedly, establishing these connections, understanding the ways in which various health concerns are linked, and recognizing the role of physical activity demonstrates the need and relevance for examining this subject from a multi-disciplinary perspective.

C. Context

To set the stage for the reviews of literature that follow, it may be helpful to first establish what is known about the general benefits of physical activity for health and well-being, as well as the current context of women's health and participation in physical activity.

The general benefits of physical activity for health

Physical activity has long been acknowledged as an important part of a healthy lifestyle, and recent scientific evidence has linked regular physical activity to a wide range of physical and mental health benefits. Research has demonstrated protective effects of varying strength between physical activity and risk for several chronic diseases, including coronary heart disease, hypertension, non-insulin-dependent diabetes mellitus, osteoporosis, and colon cancer [4, 5]. In fact, investigators suggest that 12% of the total number of annual deaths in the United States are attributable to a lack of regular physical activity [5].

From a public health perspective, research has successfully argued that more benefit is achieved when the least active persons take up exercise than when moderately active persons increase their activity by a similar amount [6, 7]. This recognition of the importance of physical activity for general health has been paralleled in the development of a new exercise prescription by the American College of Sports Medicine (ACSM) advocating that "every U.S. adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week" [5, 8].

Although studies have identified a positive relationship between increased levels of physical activity and better mental health, less depression and lower levels of anxiety [9, 10], there is still a serious lack of hard evidence in the area of psychological well-being to support the equivalent relationship as has been established between exercise and physical health [8]. At the same time, it has been speculated among health practitioners and the public that, in many cases, the psychosocial benefits of physical activity for mental health may actually outweigh the physical benefits. Regardless of the specific mechanisms that produce positive health benefits from involvement in regular physical activity, evidence for both the mental and physical health benefits of physical activity particular to girls and women has yet to be presented in a comprehensive literature review.

Health status

With respect to health, women have a greater life expectancy than men, but are also more likely to experience illness, violence and poverty. Women have been found to practice better health habits [1, 9], although "over a lifetime ... they suffer more ill health and are more frequent users of the health care system" [9]. In general, women are poorer than men and make up the vast majority of low-income single parents [11]. As well, they often carry a double workload, one in the paid work force and one in the home [1].

Women have a distinctive relationship with "health" in our society partly because of their reproductive capacities, but also because of their multiple roles. Women provide most unpaid and informal health care

services and play a key role in influencing the health behaviour of others in their families [12]. In relation to the professional health care system, women represent approximately 80% of all health care workers and tend to be stratified in the low-paying and low-status positions [9].

In many ways, the main health worries and problems reported by Canadian women reflect the social realities of their lives, especially with respect to psychosocial health. When women are asked about their main health worries, cancer, heart disease and road accidents top the list. However, when asked about their most bothersome health problems, women identify stress, arthritis, being overweight, migraines/ chronic headaches and tiredness in descending order [13]. Canadian women also identify the primary social problems as violence, discrimination in the labour force (including pay inequity), single motherhood problems, financial problems, day care and the pressures of multiple roles [13].

Other important considerations are the physiological differences between women and men, in terms of women's relationship with physical activity and response to exercise as a stressor on the body. For example, women produce minimal amounts of testosterone, which limits the potential for muscle hypertrophy. As well, women have a higher percentage of essential body fat, and also have a lower centre of gravity due to body fat distribution and skeletal structure. The cumulative effect of these factors substantiates the fact that women have a distinctive relationship with health and physical activity.

Participation in physical activity

Although levels of inactivity in Canada are decreasing [15], current participation research has found that the majority of Canadians can be classified as inactive or sedentary [16]. Low levels of physical activity are especially prevalent among girls and women in comparison to boys and men [15, 17-19]. With respect to the participation of adults, most studies have found lower vigorous activity levels among women than men, particularly at younger ages [20]. Physical activity has consistently been found to decrease with age after late adolescence or early adulthood [20].

Women and girls who are also visible or immigrant minorities, socioeconomically disadvantaged, older, less educated, or disabled are the least active due to the experience of multiple social, individual and structural restrictions [20-27]. Some of the causes of inactivity have been explained by commonly experienced barriers to participation in traditional recreation and leisure activities, such as time, money, community/facility accessibility, and knowledge [12, 20, 28-32].

King and colleagues [20] found that black women, the less educated, overweight individuals, and the elderly emerge as the most consistently reported inactive groups in terms of overall physical activity. However, the identification of other population groups as inactive appears to be generally a function of the type of physical activity being measured. Women, for example, are less active then men if sporting or vigorous activities are a prominent component, but may be similarly active when household and other chores are included [33]. Some population segments may walk specifically "for exercise" but may walk significant distances for other reasons. This complicates attempts to gain a true picture of both current activity levels and the relationship between physical activity and well being.

Research data is also insufficient in the area of recreational sport activities, which has seen a large increase in participation by girls and women but is not well documented. There is little reliable information at the community and recreation sport leagues and programs level [34]. The National Sporting Goods Association survey in the U.S. indicated that girls and women are more active in fitness and have a higher participation rate, as opposed to men and boys who are more likely to play competitive sports. Unfortunately, this data does not consider race, class or age [34]. Differences in participation based on types of activity was confirmed by Smale and Shaw [31] who surveyed adolescents and found that females have lower levels and rates of participation in team sports than males. They tend to participate in more individual sports and physical activities than males, but their rates of participation in such activities are lower. Beginning at age 12, involvement of girls declines steadily until only 11% are involved in physical activity and recreation by grade 11 [31].

Girls are reported to undervalue and underestimate their capacity and potential for competency in physical activity. Adolescent girls report more barriers to participation than do boys, including time, money, resources, and a concern for safety. Lack of active, older role models has also been cited as a contributing factor to lower participation rates among girls [35; p. 31].

Among older adults, differences in physical activity participation rates, though somewhat smaller than in younger ages, persist [20]. However, when light and moderate activities are included in the determination of regular leisure-time activity levels, the gender difference diminishes or disappears [20]. The 1995 Physical Activity Monitor [36] found Canadians over the age of 65 are less active now than at the end of the eighties. Older women are the least active of all age and sex groups. In fact, middle-aged men and women, along with men over 65, are twice as likely to be active as older women are. Men and women in their early twenties are three times more likely to be active [36].

Current evidence strongly supports the value of regular physical activity in preventing and treating many physical and mental health concerns and diseases. The association of low physical fitness with an increased risk of mortality is dependent on physiological risk factors, but psychological variables such as anxiety and depression have not been adequately evaluated as possible confounders for all-cause mortality. We currently have a limited understanding of the relationship between psychological variables, physical activity and health, and the unique experiences of, and diversity among, girls and women. There is a need for a context-specific, multi-faceted review of the biomedical, behavioural, and psychosocial literature to ensure that the physical activity and health needs of girls and women are adequately and equitably addressed in the decision-making and resource allocation of practitioners and policy makers.

D. Key Definitions

In order to compare and contrast current studies and make research recommendations for the future, it is necessary to provide working definitions of concepts related to physical activity, health, and well-being, in addition to the clarification of related research and measurement issues. What follows is a brief discussion of the various relevant concepts including physical activity, health, well-being, and diversity. A more in-depth discussion of the concepts specifically related to physical activity (exercise, sport, recreation, leisure, active living, and measurement issues) can be found in Appendix A.

Physical activity

Physical activity is typically defined as any bodily movement produced by skeletal muscles that results in energy expenditure above the basal level. Physical activity can be categorized in various ways, including type, intensity, and purpose or context [37]. Physical activity is the broad and organizing concept around which more specific activities can be arranged. Physical activity, performed as sport and exercise, can also be understood within the context of leisure, recreation and active living.

Health

The 1988 International Consensus Conference on Physical Activity, Physical Fitness, and Health [37] defined health as:

> … a human condition with physical, social and psychological dimensions, each characterized on a continuum with positive and negative poles. Positive health is associated with a capacity to enjoy life and to withstand challenges; it is not merely the absence of disease. Negative health is associated with morbidity and, in the extreme, with premature mortality [37; p. 22].

Some researchers expand the definition of health to include the social determinants of health. In a recent article on women's health and the contribution of physiotherapists, McComas and Harris [38] use a definition of health that considers the social context of women's health:

> Women's health involves women's emotional, social, cultural, spiritual and physical well-being, and it is determined by the social, political and economic context of women's lives as well as by biology. This broad definition recognizes the validity of women's life experiences and women's own beliefs about and experiences of health [Phillips, 1995; cited in ref. 38].

It is this rich and contextual definition that provides the starting point for an understanding of health in the literature that is reviewed for each chapter.

Well-being

The term "wellness" or "well-being" implies that there is more to health than the absence of disease or disability. Well-being may be considered to involve the following: improved quality of life, efficient functioning, the capacity to perform at more productive and satisfying levels, and the opportunity to live out one's life span with vigor and stamina [39]. Although well-being has often been equated with mental health, the "emerging consensus among researchers is that the term 'well-being' implies an emphasis on the individual's perception or sense of wholeness of self, groups or community" [10]. Therefore, for the purpose of this study, well-being is considered to be both individual and collective, multi-dimensional (i.e., physical, emotional, psychological, spiritual and social), and determined by subjective experience. In this way, well-being may be understood to contribute to positive health. However, although health may contribute to high-level wellness, health is not necessary for general well-being. For example, a woman with a debilitating disease such as multiple sclerosis may struggle with poor health but may have a strong sense of well-being.

Diversity

The consideration of diversity among girls and women in North American society has been significantly neglected in both health and physical activity research. This is especially true for those who are marginalized within mainstream culture. The dominant cultural and social norms of the white, middle-class, heterosexual and able-bodied society are not inclusive of a great number of Canadian women and girls. In recognition of this imbalance, this document pays specific attention to the place of marginalized women within the research.

In order to identify and characterize the relationship between physical activity and positive health and well-being for girls and women, the following diversity domains were considered during the literature search and review: age/lifecycle, race/ethnicity, disability/ability, sexual orientation, and socioeconomic status.

E. Overview

Each chapter of this review is written by a researcher and/or graduate student affiliated with the University of British Columbia. This group of 12 multi-disciplinary academics came together, with leadership from the School of Human Kinetics, to identify the most important health issues facing Canadian girls and women, and to develop a framework that would ensure an interdisciplinary approach to understanding the relationship between these health issues and physical activity. This process was supported by a steering committee with representation from non-governmental health and advocacy organizations concerned with the physical activity and health of girls and women. The members of the steering committee helped to establish the health priorities for this review, and provided a practical perspective to ensure the relevance of the findings for policies and programs in addition to future research.

Although each chapter is based on a specific health issue, this review recognizes that the majority of the programs and policies related to physical activity and the health of girls and women are generally outside of the formal health care system. It is our intention to consider diversity, the social determinants of physical activity and health, and the social context and lifestyle of individual women in order to provide the basis for creating linkages between the health care system and community policies. It is our hope that practitioners and researchers working in the fields of physical activity and women's health will find this

review practical and use it as the basis for research and policy action. Ultimately, this literature review is intended as a contribution to a supportive community environment that will promote the health and well-being of all girls and women.

Health promotion demands a collaborative approach, and for this purpose The Health Benefits of Physical Activity for Girls and Women attempts to link disciplines, research methods, and theoretical approaches. Although as a group, girls and women continue to display a specific and unique pattern of health, well-being and physical activity, it is the diversity of the women in our communities that must influence how research is conducted, how results are interpreted, and who is included in research samples. With these factors in mind, the authors of each chapter have addressed the primary concerns related to their topics.

The nine chapters that follow address each of the most important health issues identified by the steering committee and researchers during the planning process. Each chapter is a comprehensive literature review in itself and is structured so that it may be used independently of this collection. The health issues discussed draw on a diversity of research disciplines including exercise science, medicine, rehabilitation, nutrition, psychology, sociology, women's studies and cultural studies. Each chapter is organized in a uniform manner to include:

- introduction
- literature review (with sub-headings)
- summary
- gaps in the literature
- implications for future research and public policy
- summary table(s) of literature reviewed (including research population, measures and outcome comments as appropriate)
- references

The collection begins with perhaps the most broadly based review and considers the relationship between physical activity and psychosocial health and well-being. In her review, Lesley Dyck confirms that physical activity has a generally beneficial effect on various dimensions of psychosocial health such as mood, cognitive functioning, anxiety, depression, psychological stress, and well-being. Physical activity is identified as especially important for girls in that it has been found to support the development of a positive self-concept, and for older women because it helps maintain functional capacity and sustain a positive quality of life. However, physical activity can be damaging to individual well-being through factors such as exercise addiction, over-training and the experience of social pressure on women that constrains their exercise and leisure activity.

In addition to the identification of promising research directions such as those related to understanding the individual as an agent of change (self-efficacy, personal control, stages of change), and the inclusion of social theories in multi-disciplinary investigations (social status, power and empowerment, capacity), the findings of this review stress three major implications for the development of policies and programs. These implications include: the consideration of the quality as well as the quantity of participation opportunities; the importance of tailoring programs, facilities and environments for each distinct population of girls and women; and the development of community partnerships in order to consider the multidimensional and interdependent factors that contribute to well-being.

The next two chapters by Amanda Vogel provide an in-depth look at two psychosocial issues. These are issues of body image and self-esteem, and eating disorders, both of which are particularly important to the health and well-being of girls and women in our society. In her discussion of body image and self-esteem, Vogel concludes that although appearance enhancement and/or weight control are primary motivations for women to participate in fitness programs, the research is contradictory with respect to whether being active contributes to an improvement in body image satisfaction. Self-esteem is also linked to body image and exercise. But again, self-esteem may be improved as a result of appearance enhancement through exercise, or may be diminished as a result of the process of becoming physically active and related cultural expectations of an ideal female physique.

Although the relationship between body image, self-esteem and physical activity has been well established, Vogel identifies four important areas for future research to focus on in order to develop policies and programs that support women's health and well-being in this area. These research needs include: quantitative research that considers women's interpretations of a fit female body; measurement techniques designed to reflect a changing female body image and "ideal" figure; practical solutions for women to use to alleviate body image concerns and enhance self-esteem, and a greater consideration of diversity with respect to age, race, sexual orientation and socioeconomic status.

In reviewing the literature on eating disorders, Vogel found that the likelihood of developing an eating disorder increased for those girls and women who were involved in competitive sports that stress a thin physique and body aesthetic, especially for those who combined food restriction with an increase in physical activity. However, there appear to be other factors, such as the potential conflict between sport and the "feminine ideal", cultural difference related to ethnicity and body image, and emotional/psychological differences between individuals that suggest the research concerned with disordered eating among active women is inconclusive. And although the research done with women who are recreationally active as opposed to elite or professional athletes lends further insight, there is a significant lack of information in this area.

In spite of the lack of conclusive evidence regarding the quality of the relationship between physical activity and eating disorders, the existence of the relationship itself has been clearly established. The implications of this relationship suggest several issues for policy makers and programmers to consider in support of positive health and well-being for girls and women. Many of these issues are related to the role physical educators and instructors play in the prevalence of eating disorders, such as promoting an unattainable body image, not stressing other benefits of physical activity such as health and fun, and over-emphasizing diet as an appropriate method of weight control. Other issues are related to the sociocultural values and attitudes that are transmitted and constructed through advertising and promotional materials in our society. Policy change must be directed at dissociating extreme thinness with the purpose of exercise or the ability to succeed in certain sports by counteracting media messages and ensuring fitness and exercise professionals are communicating appropriate messages about being fit and healthy.

Chapter four tackles the issue of smoking cessation and touches on the related topic of drug rehabilitation. In her review of this literature, Susan Crawford found that although physical activity appears to have a logical role in helping women reduce or arrest their use of psychoactive substances, the complexities of replacing a habitual behaviour, that generally carries a physiological dependence, with an entirely new behaviour are enormous. The relationship between exercise adoption and smoking cessation is poorly understood. Cigarette smoking is a largely intransigent behaviour because it is chemically, behaviourally, and socially reinforced. Whether physical activity can assist in reducing the power of these rewards is unknown. This situation is further complicated by socioeconomic factors that indicate smoking and physical inactivity are more likely among those women who have a low income and the least education.

These findings have several implications for policy and program development. Although physical activity cannot be claimed to be a beneficial adjunct to smoking cessation and maintenance strategies, it does not appear to be a detriment and should be recommended on the basis of the established benefits of physical activity for health and well-being. The promising research on the stages of behaviour change suggests that any intervention strategy should be tailored to the appropriate stage. And finally, social, psychological and economic factors need to be considered in the development of any strategy, such that the low-income and the least active women get the support they need to reduce or quit their use of tobacco and other psychoactive substances.

Although it has traditionally been considered to be predominantly a male disease, it is finally being recognized that cardiovascular disease (CVD) is a leading cause of death for both men and women. In her review of cardiovascular disease literature in chapter five, Susan Crawford found that there are significant gender differences in the manifestation and outcome of CVD, and that a sedentary lifestyle is a major but modifiable risk factor for heart disease. Physical activity has been found to protect against

the risk of CVD mortality in women as a primary effect independent of risk factors (such as age, cigarette smoking, type 2 diabetes mellitus, overweight, hypertension and total cholesterol), and as a secondary effect of risk factors being favourably altered. However, there is still a need for more research on older women, and better instruments to measure physical activity in the context of daily life for women.

In their chapter six review of the role of physical activity in the prevention of osteoporosis, authors Moira Petit, Heather McKay, and Karim Khan consider the implications of exercise over the life span. They conclude that in addition to the hormone replacement therapy that is often prescribed for the post-menopausal woman, maximizing peak bone mass during the growing years may be an effective means of preventing osteoporosis in later life. Due to the recent dramatic increase in the risk for fracture among older women, osteoporosis prevention strategies need to be aimed at the entire population of girls and women. Research has demonstrated that physical activity plays a critical role in the attainment of peak bone mineral density during the growing years, in the maintenance of bone during the premenopausal years, and for slowing bone loss during the postmenopausal years.

In addition to specific recommendations for future research, Petit, McKay and Khan identify several policy and program strategies to support optimal bone-health through physical activity. For example, starting early in life (prepuberty) and maintaining throughout a lifetime, girls and women should participate in high-impact, weight-bearing activities that include varied and diverse movements. Physical education programs can support this by targeting elementary school children, ensuring programs include “bone healthy” activity throughout the school years, and avoiding an exercise program that is combined with inadequate energy intake which disrupts normal menstrual cycle function. All girls and women need to be supported to ensure a healthy diet of adequate calcium, vitamin D and number of calories, as well as access to physical activity programs in the community regardless of income, ability or ethnicity. Those women and girls who have limited mobility or are prescribed bed-rest should incorporate some minimal form of weight-bearing in their daily routine. And finally, older women need to add exercise aimed at increasing muscular strength and balance to assist in the prevention of falls.

Chapter seven addresses a specific group of cancers that are a major health risk to Canadian women due to their estrogen-dependent characteristics. In this chapter, Kristin Campbell and Susan Harris consider the link between physical activity and the dominant estrogen-related cancers including breast, endometrial, and ovarian cancers. They conclude that although research has not been able to identify many mechanisms that can be manipulated to prevent estrogen-related cancers, physical activity is one that does appear to be effective toward primary prevention. In particular, research has found strong support for the protective benefits of physical activity for endometrial and ovarian cancers. With respect to breast cancer, most studies demonstrate only a slight to modest protective benefit for physical activity. As a result of these findings, regular exercise needs to be considered as a critical variable in promoting the overall health of women. And because recreational physical activity, in contrast to work-related physical activity, is a more easily modifiable lifestyle factor, it makes sense that this should be the target for the support of women who are at risk for estrogen-related cancers.

In addition to the bone density and cardiovascular health issues that are related to menopause and discussed in chapters five and six, there are a number of menopausal symptoms that impact the health and well-being of women. In her review of the relationship between physical activity and the alleviation of menopausal symptoms, Susan Crawford found that because there is still some uncertainty around the true etiology of symptoms such as hot flushes, and confusion about whether other symptoms are linked to estrogen withdrawal, the role of physical activity in the attenuation of menopausal symptoms is unknown. Part of the difficulty in making this link is the lack of adequate tools to measure participation in physical activity, resulting in an inability to link participation rates to menopausal symptoms. The investigation of menopausal symptoms is also problematic in many cases due to the fact that the recognition of symptoms at the menopause appears to be social and culturally driven. As a result, it may be too early to recommend the development of physical activity programs for the specific purpose of reducing menopausal symptoms. However, the benefits of exercise for mental health and well-being, as well as bone and cardiovascular health of women in midlife are clear, and suggest that regular physical activity would be beneficial in any respect.

Finally, chapter nine addresses the relationship between physical activity and the health problems of fibromyalgia and chronic fatigue syndrome. The authors Candice Schachter and Angela Busch found that the literature supports the use of aerobic exercise in the management of fibromyalgia and chronic fatigue syndrome. However, most of the studies cited examined only short-term effects of supervised or semi-supervised exercise, and the improvements that were noted were not found for every aspect of the conditions. In general, the research on the relationship between physical activity and fibromyalgia and chronic fatigue syndrome is very limited and needs a great deal more attention, especially in the areas of long-term effects, exercise in a home-based setting, and the consideration of population diversity in the samples selected.

The concluding chapter summarizes the general implications for future research, program and policy development based on what has been established in this review of the literature with respect to the relationship between physical activity and the health and well-being of girls and women. The summary of the implications is organized around several key recommendations that cut across traditional disciplines. These recommendations include strategies for enhancing our understanding of the relationship between physical activity and health status, supporting increased participation in physical activity, and enhancing health and quality of life through physical activity for girls and women.

F. Appendix A

Definitions Related to Physical Activity

Physical activity is typically defined as any bodily movement produced by skeletal muscles that results in energy expenditure above the basal level. Physical activity can be categorized in various ways, including type, intensity, and purpose or context [37]. Physical activity is the broad and organizing concept around which more specific activities can be arranged.

Exercise and sport

Exercise and physical activity have been used synonymously in the past, but more recently, exercise has been used to denote a subcategory of physical activity. Exercise is "physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is the objective" [Casperson, Powell & Christensen, 1985, cited in ref. 37; p. 20].

Training for fitness objectives generally involves some combination of aerobic and anaerobic exercise. Aerobic exercise refers to activity performed at an intensity that allows the metabolism of stored energy to occur through the use of oxygen. Examples of aerobic activities include the sedentary activities of daily life, as well as higher intensity exercise such as walking and running where the heart rate is elevated and the activity is performed over a longer duration (three minutes or longer). In contrast, anaerobic exercise refers to movements performed at an intensity that requires the metabolism of stored energy without oxygen. This type of activity includes intermittent high-intensity exercise such as weight lifting, basketball and sprinting.

Sport can be defined as "institutionalized competitive activities that involve vigorous physical exertion or the use of relatively complex physical skills by individuals whose participation is motivated by a combination of intrinsic and extrinsic factors" [40; p. 21]. Play and sport are different, although play can be sport-like in nature and sport can be playful [41]. While sport must contain certain elements to varying degrees such as physical skill, competition, institutionalized rules and a socialization process, sport does not have inherent age or performance level requirements [41].

Recreation, leisure and active living

Rather than describing specific activities, the concepts of recreation, leisure and active living provide the context for the performance of physical activity and therefore influence the quality of the experience.

Recreation can be understood as physical activity pursued by groups or individuals during leisure time, although it can also be much broader than physical activity. It is depicted as being voluntary and pleasurable, and providing immediate and inherent satisfaction to the participant [41]. Recreation is more closely related to play than sport, "but unlike play, it is generally a response to the concerns of ordinary life rather than a free and spontaneous activity" [40; p. 21]. And although recreation happens during leisure time, some theorists suggest that leisure is a human phenomenon while recreation is a social one. "Recreation is different from leisure. It is closely associated with the industrial revolution, it is somewhat culture-bound, it exists in part to achieve broader social purposes (and, perhaps, political purposes), it generates enjoyment, and it occurs as one form of expression during leisure" [42; p. 39].

In contrast, leisure can be understood as subjective, with the perception of freedom as central to the experience. Leisure may be viewed as time, activity or the condition of the individual but it does not apply to all cultures and, especially for women, includes more than physical activity [42].

The concept of "active living" developed out of a policy perspective, which understands physical activity as more than physical fitness. Starting from a definition of fitness as "a state of total well-being of the

individual – physical, mental, spiritual, emotional and social" [43], researchers, practitioners and policy makers at the 1986 Canadian Summit on Fitness defined active living as "a way of life in which physical activity is valued and integrated into daily life" [Government of Canada, in ref. 44; p. 33]. Active living is based on three principles; it is individual, social and inclusive. The objective of an active living approach is to encourage and support personal choices to live actively in daily life. Active living may include sport and exercise, but traditional and structured forms of physical activity are not necessary to live actively [44].

According to Active Living Canada, an active living approach has the potential to improve health and well-being because it speaks to a future "where being active is the norm, not the exception, and that the simple joys of moving will transcend the mere pursuit of improved strength, endurance, or a more desirable weight or shape" [Active Living Canada, 1993, in ref. 44; p. 32].

For the purpose of this review, the physical activity domain is considered to include physical activity, exercise, sport, leisure and recreation. Because active living is a relatively new and loosely defined term, it generally was not found in the literature and was determined to be useful primarily as a way to understand physical activity in the context of daily life.

Measurement and assessment issues

There are a number of specific measurement issues that are dealt with in detail in each chapter as is appropriate. However, there are several basic measurement standards and issues with respect to physical activity that remain constant in every context. These include: dimensions of physical fitness, exercise intensity, and frequency and duration measures.

Physical fitness can be described as the ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies. Physical fitness includes cardiorespiratory endurance, skeletal muscular endurance, skeletal muscular strength, skeletal muscular power, speed, flexibility, agility, balance, reaction time, and body composition. It is a set of attributes that are either health or skill-related. The degree to which people have these attributes can be measured with specific tests [37]. Just as the amount of physical activity can range from high to low, so can the level of physical fitness. For example, a person may be strong but lack flexibility.

As an outcome measure for the benefit of physical activity, fitness has proved useful for understanding and comparing exercise and sport-related activities. However, researchers are reconsidering the findings of some studies that conclude low-intensity physical activity results in limited health benefits due to a lack of measurable fitness gains. Recent evidence suggests that health benefits can result even with no change in physical fitness.

The traditional focus for measuring physical activity has been related to training intensity to meet performance and fitness objectives. Energy expenditure for this type of physical activity is typically measured in kilocalories. This technique creates measurement difficulties associated with assessing daily physical activity located in occupational tasks, household chores and incidental activity such as walking [45]. These types of activities are variable and difficult to break down into component parts, not to mention the difficulties with reproducing them in a laboratory setting.

More subjective measures are often used in these cases and include observations and self-perceived exertion (such as the Borg Scale of Perceived Exertion). For example, very light activities have been described as those requiring slow breathing with little or no movement. Light activities include those requiring normal breathing and regular movement. Medium activities are those requiring increased breathing and moderate movement, while hard activities are those requiring hard breathing and moving quickly [46].

Researchers generally agree that physical activity should be conceptualized in terms of frequency, intensity and duration. Data from a Canadian National survey provide indirect evidence to support the contention that the three components (frequency, intensity and duration) have different determinants [46].

The appropriate combination of frequency, intensity and duration for positive health benefits has been a significant concern of exercise research for the past 30 years. Starting in the late 1970s, the American College of Sports Medicine (ACSM) promoted the “20 minutes of vigorous activity 3 times a week” formula to improve fitness. The ACSM now recommends that for health benefits, adults “should accumulate 30 minutes or more of moderate physical activity over the course of most days of the week” [7]. Researchers suggest that this formula contributes to improved health, especially for less active people, and is realistically achievable by the majority of the population [6, 7]. However, there is still the difficulty in determining standards for the measurement of “moderate” physical activity in the context of daily life, such as for chores like laundry, childcare and grocery shopping.

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I. PSYCHOSOCIAL HEALTH AND WELL-BEING

Lesley Dyck, M.A.

A. Chapter Overview

What do we know?

Physical activity has a positive effect on mood, cognitive functioning, psychological well-being, and negative mood associated with pre-menstrual syndrome (PMS), and has been shown to decrease levels of anxiety, depression, and psychological stress.

For girls, physical activity is especially important in the development of a positive self-concept and contributes to general health.

For older women, regular physical activity helps maintain functional capacity and sustains a positive quality of life into old age.

What do we need to research?

There are a number of psychological and social health constructs (stress, anxiety, depression, self-esteem, self-efficacy, locus of control, prosocial behaviour, violence, aggression, mood state, well-being). These constructs are measured using a variety of scales and research methods (cross-sectional, longitudinal, questionnaire, biophysical measurement, interviews, observations, etc.), and involve predominantly white, middle-class, able-bodied, male research participants. As a result, there is a great deal of speculation as to the size, direction, and causal mechanisms related to the general finding of the benefit of physical activity for positive well-being, especially among girls and women.

It is important to include a diverse representation of girls and women in research so that we can continue to learn about the specific health benefits of physical activity for different populations of females.

What should we do?

There are three basic principles that are important for the development of effective social policy to support the participation of girls and women in physical activity:

- Consider participation opportunities, including both the number and the quality of physical activity opportunities for girls and women.
- Provide tailored programming, developing responsive facilities and environments for distinct populations of girls and women, based on age, ethnicity/race, activity levels, socioeconomic status, and ability.
- Build community partnerships to reflect the multidimensional and interdependent nature of health and well-being for girls and women.

B. Introduction

The purpose of this chapter is to examine the perceived benefits of physical activity for psychosocial health and well-being, and consider the evidence with special attention to the implications for the well-being of girls and women. As was described in the introduction to this report, physical activity has long been acknowledged as an important part of a healthy lifestyle, and recent scientific evidence has linked regular physical activity to a wide range of physical and mental health benefits. Although many studies have identified a positive relationship between increased levels of physical activity and better mental health, less depression and lower levels of anxiety [1, 2], many researchers argue that there is still a serious lack of hard evidence in the area of psychological health and well-being to support the equivalent

relationship between exercise and physical health [3]. However, other researchers suggest that there is increasing evidence for the health and well-being benefits of physical activity for girls and women when both the psychological and social dimensions are considered [4-7]. In addition, numerous practitioners in the field report mounting “anecdotal” evidence for the psychosocial benefits of positive and supportive physical activity for girls and women.

This chapter begins by establishing several working definitions relevant to the exploration of psychosocial health and well-being. The gendered experience of physical activity and health is then briefly discussed in order to establish the context and to underscore the importance of understanding how physical activity contributes (or not) to health and well-being for girls and women in particular. General research issues are then considered, followed by a review of the literature that addresses specific psychosocial dimensions of health and well-being. The literature review is grouped according to the general relationship the psychosocial dimensions are considered to have with physical activity. That is, factors such as stress and anxiety that have been shown to decrease with an increase in physical activity are described as “negative affect” factors, while those such as self-efficacy and mood that have been shown to increase or improve with an increase in physical activity are described as “positive affect” factors. A third group is organized around “negative outcomes” and includes risks associated with physical activity such as exercise addiction and over-training. A separate section addresses some of the dominant issues in reference to specific populations, followed by a brief summary and a final section on research and policy implications.

1. What is psychosocial health and well-being?

One of the primary difficulties in attempting to understand the link between physical activity and “psychological”, “psychosocial”, or simply general health and “well-being”, is the lack of accepted definitions for any of the above terms. Although we may have an intuitive sense of what is meant, the difficulties associated with operationalizing the concepts for measurement and discussion purposes make the establishment of clear relationships a challenge. It seems reasonable to assume that both general health and well-being are based on physiological, psychological and social processes as experienced by the individual. The complexity and interrelated nature of these processes make it difficult to separate out specific dimensions of health and well-being and establish specific relationships with physical activity. As a result, researchers have tended to operationalize dimensions of psychological/psychosocial health and well-being based on previous research definitions, unexamined assumptions and theoretical constructs. This review will attempt to create several general definitions based on the dominant definitions currently in the literature. However, several recent theoretical models that show considerable promise for enhancing our understanding of psychological and psychosocial health and well-being of women and girls will also be presented.

Psychosocial health can be broadly defined to include psychological or mental dimensions, and social or interpersonal relationship dimensions, although there is no accepted definition in the field. Some researchers use the concept of “emotional health” to capture the essence of both the psychological and social dimensions, and distinguish between mental health and mental well-being by including sociological issues such as gender and social conflict as part of mental well-being [4]. However, in many cases “emotional health” does not address a number of important social or interpersonal relationship/power issues such as ethnic diversity, sexual orientation and socioeconomic status. As a result, this review will consider psychosocial health as a broader and more holistic concept.

Breaking psychosocial health down to the psychological and social components, psychological health is sometimes differentiated from mental health as having a greater emphasis on well-being, in contrast to the greater emphasis mental health puts on the presence or absence of disease. However, for the purpose of this review psychological and mental health will be used interchangeably and will not include specific issues related to mental illness. Psychological health is usually considered to include positive characteristics such as high self-esteem and self-concept, positive mood, and enhanced motivation, optimism, coping ability, concentration and judgment. Psychological health has also been considered to include reduced levels of negative affect such as anxiety, depression and anger. Recently however, other aspects have been studied such as cognitive functioning and stress reactivity, as well as the potential negative psychological effects of exercise [8].

With respect to women and mental health, a significant amount of research on physical activity has paid attention to what are often considered moderating factors for positive mental health. These include physical health (absence of disease, fitness level), weight control as a component of self-image and self-esteem, functional independence as a result of fitness level and self-efficacy especially among older women, and the influence of PMS and menopause with respect to negative mood and depression [9]. A number of studies addressing issues of psychological health and physical activity have, in fact, also included several dimensions of social health. In a meta-analysis of mental health, researchers considered mental health to also include subjective well-being, coping, happiness and life satisfaction [10]. Social health can therefore be understood to include social factors such as subjective perceptions of relationships, the social construction of gender, ethnic/cultural diversity, and socioeconomic status, that may act to moderate psychological health and general well-being.

As was described in the introduction, well-being has often been equated with mental health, although most researchers now understand it to emphasize personal perception and a sense of self, groups and the community. Well-being can be understood to include both objective factors such as personal characteristics and quality of life variables, and subjective factors such as satisfaction and happiness. In this context, satisfaction is considered to be a relatively stable indicator of discrepancy between goal and achievement, and happiness is a more temporary response to a current situation [2]. Because this review uses a very broad and inclusive definition, psychosocial health and psychosocial well-being are used interchangeably. General well-being is used to describe an inclusive and multi-dimensional (physical, emotional, psychological, spiritual and social) understanding of holistic health.

2. Alternative models of psychosocial health and well-being

Part of the difficulty in defining psychosocial health and well-being is related to the challenge of establishing measurable psychological and social factors, and articulating the relationships between the various factors. In many respects, examining the linkages between physical activity and psychosocial health may contribute to the development of theoretical models of well-being and therefore to our understanding of well-being. For example, research on perceptions of leisure opportunities and assessments of quality of life have shown that leisure values are significant and positively related to perception of quality of life [Jeffres & Dobos, 1993; cited in ref. 2], suggesting that leisure (and therefore physical activity in this context) may be an important factor for well-being. However, the current models of well-being and psychosocial health do not generally consider the social and cultural contribution of physical activity.

Investigations into the potential health benefits of leisure have required the consideration of dimensions such as situational factors (i.e., categories of experience), person factors (i.e., locus of control), as well as their interaction [11]. In a recent paper, Haworth [11] considered the application of a categorical, situation-centred model of mental health developed by Warr [12]. In this model, nine principal environmental influences are proposed as having a significant non-linear influence on mental health. These influences include: opportunity for control; opportunity for skill use; externally generated goals; variety; environmental clarity; availability of money; physical security; opportunity for interpersonal contact, and valued social position.

> Warr suggests that, like vitamins, these features have non-linear effects, some improving mental health up to a certain point and then having no further effects, others producing benefits up to a certain level but beyond which increases would be detrimental [11; p. 54-55].

In support of this environmental categorical model, five principal components of mental health have been proposed. These include affective well-being, competence, autonomy, aspiration and integrated functioning. The most developed component is that of affective well-being which has been measured on three axes: pleasure-displeasure, anxiety-contentment and depressed-enthusiasm. Integrated functioning is concerned with the multiple relationships between the other four components and does not yet have questionnaire measures [11]. Because this model considers such things as the position of the individual

n a valued social structure and person-situation interactions, it has the potential to make a significant contribution to understanding the experience of physical activity in the context of leisure for women, and therefore the contribution it may make to the psychosocial well-being of women.

> In this model, positive experiences in leisure may have a critical part to play in the chain of events associated with well-being. In investigating these complex areas, small-scale questionnaire studies could be combined with more in-depth methods, including the ESM (experience sampling method), interviews, and descriptive accounts, to form an empirical and experiential ethnography of leisure and health [11; p. 60].

Other models of well-being that may be relevant to understanding the link between physical activity and psychosocial health have considered health from a more holistic perspective. An example of this model is one developed by Crose, Nicholas, Gobble and Frank [13] in order to consider gender issues and wellness. Their multidimensional systems model was developed for counselling and includes six life dimensions: physical, emotional, social, vocational, spiritual, and intellectual. It is based on the principle that health is multidimensional, variable and self-regulating within and between dimensions.

> Culture, age, and gender differences are extremely important to understanding different reference values, which affect the cybernetic self-regulating aspects of this model, and different patterns of development, which affect the reverberating fluctuations along each continuum for the separate health dimensions [13; p. 151].

A multidimensional systems model may help to consider health differences beyond biological differences between men and women. For example, women are more likely to receive a diagnosis of mental disorder, are more often prescribed psychotropic medication, and take more prescription and over-the-counter drugs. Men are found to have significantly higher rates of alcohol abuse and antisocial personality, where women are approximately twice as likely to have affective (primarily depression), anxiety, or phobic disorders [13]. In a multidimensional systems model, these sorts of differences are reflected in the variable balance that may be achieved between the dimensions of health depending on the individual, and suggest gender differences in overall well-being.

Although the idea that physical activity may make a variable contribution to psychosocial well-being depending on the individual has not generally been considered, this approach shows significant potential by simultaneously valuing individual diversity and the social context. Using this variable balance and multidisciplinary model to investigate the relationship between physical activity and psychosocial well-being may also have the potential to resolve certain design and methodology flaws. For example, it is often difficult to draw reliable conclusions from studies on exercise, anxiety and depression as these studies are often not able to describe a true and independent effect of physical exertion rather than a nonspecific effect of expectancy or selection bias or social interaction [14]. Perhaps this dilemma could be resolved, at least in part, by taking a less reductionist approach inherent in a multidisciplinary and systems model. Although the two models of well-being discussed here are not exhaustive of all the models that are available, they demonstrate the value of enriching our working definitions of psychosocial health and well-being in order to deepen our understanding of the links between physical activity and psychosocial health and well-being.

3. The gendered experience of physical activity and health

It remains true that in most societies the male is valued more highly than the female.

> Men are usually dominant in the allocation of scarce resources and this structured inequality has a major impact on women's health [15; p. 1].

Women in our society have less power in the community, less control over their own lives and less access to resources than men – a relationship that is reinforced every day by social norms and practices. In contrast, it has been argued that one of the main benefits of leisure for women is the opportunity for women

to control their bodies and ultimately their lives through leisure, and this has been theorized to result in a heightened sense of control in other aspects of life [16].

Although it is convenient to consider that women share a great deal of meaning based on the common ways they experience and understand physical activity, health and leisure, it is important to recognize that life situation has a profound influence. For example, some researchers have concluded that "the same activities can have different meanings for different individuals or even for the same individual at different points in the life cycle" [Osgood & Howe, 1984; cited in ref. 17]. Unfortunately, research that considers diversity is still relatively underdeveloped in health, leisure, and physical activity literature [6, 7, 15, 18], and many assumptions about the links between psychosocial health and well-being are based on male norms.

In an attempt to understand the relationship between gender, physical activity and health, theorists have examined the "body" as a lived experience that is socially and historically situated and interpreted by the self, rather than as an abstract universal concept [19].

> This requires bringing into the theoretical foreground the processes and practices of everyday life through which the body is constructed and known in its concreteness and particularity [20; p. 7].

In his recent study, Saltonstall [20] reported that the healthy body was rarely referenced in universal, non-gendered terms, but rather the body was considered in its context of who and where.

> From a theoretical point of view, this suggests that the doing of health is a form of doing gender [20; p. 12].

This concept is extended to physical activity when the congruence of health ideals and physical ideals in contemporary Western culture are considered. For the most part, gender constrains physical activity for women and girls. There is evidence that for women slimness is ideal, although toned muscles are admired if they do not add significant bulk. In contrast, men who are muscular are valued as long as there Is not any visible fat. The image of the fit body is heavily gendered and often sexist [21].

The power relations of our society structure these constraints that provide the resources, opportunities and social support for boys and men to be active, while simultaneously limiting them for girls and women. The constraints are also reproduced by women and girls themselves from the social location of their "body". Girls learn at a very early age what kinds of activities are "acceptable" for them and how they should control their bodies through diet and exercise to enhance their "feminine" qualities as they become women. Within the context of the gendered experience of physical activity and health, it is clear that the performance of physical activity by girls and women may be a difficult and potentially "risky" activity with respect to psychosocial well-being, especially if they act against social and cultural norms. However, the psychosocial benefits (or risks) of physical activity have not generally been considered from this perspective.

C. Literature Review

1. Overview and issues

Most of the research related to physical activity and psychosocial health and well-being has been conducted within the field of exercise psychology. Several extensive reviews provide positive, if somewhat tentative, support for the role exercise can play in the promotion of positive mental health [3]. In a consensus statement, exercise and sport researchers agreed that:

> Exercise has a consistent beneficial effect on mood and psychological well-being, anxiety, depression, and psychological stress and may enhance cognitive functioning [22; p. V].

Although these conclusions are based on a number of controlled studies, they do not necessarily suggest a causal relationship between physical activity and psychological health, or reduce the underlying mechanisms to a specific physiological system.

> Perceived psychosocial benefits may occur in the absence of clearly identifiable changes in physiological parameters, just as it is possible to establish physiological changes in the absence of any perceived psychological benefits [3; p. 111].

In most review articles on the benefits of physical activity for psychological health, the relationship has been considered with respect to positive and negative correlation. Generally there is a positive correlation between exercise and self-esteem, self-efficacy, psychological well-being, and cognitive well-being (i.e., an increase in physical activity is related to an increase in self-esteem). The negative correlation tends to be between exercise and anxiety, stress and depression (i.e., an increase in physical activity is related to a decrease in anxiety). While these correlations are important for understanding the general benefits of physical activity, they do not establish how exercise can be used to alleviate particular symptoms, what forms of exercise are most beneficial in specific situations, or in establishing the direction of causality [3]. This lack of a clear dose-response relationship makes it difficult for health and exercise practitioners to prescribe physical activity in response to certain symptoms or situations. Some authors argue that although a dose-response relation is valuable for understanding the physiology of exercise, it is not able to consider cognitive and emotional experiences during exercise.

> Hence the complexity of the relation in terms of both dose (activity type, frequency, intensity, and duration) and possible responses, makes it difficult to envisage research ever having the potential to move from description to prescription in relation to mental health [3; p. 112].

In general, studies that have considered psychosocial outcomes in response to the amount and type of exercise have found that there is a ceiling effect with respect to benefits. As a result these studies lend support to the idea that low to moderate levels of aerobic exercise are the most beneficial for enhancing mood and improving psychological functioning [3, 22]. However, this conclusion does not necessarily hold for all of the different psychological functions or dimensions being evaluated, or for overall mental health. Part of the difficulty is related to methodological inconsistencies across studies, but also to the differences between psychological dimensions. The evidence in support of the benefit of exercise for specific psychological dysfunctions such as depression, anxiety and stress is strong for clinical populations, but merely compelling for mentally healthy individuals. Scully et al. [3] speculate that this could be because healthy individuals may have very little room for improvement.

2. Dimensions of psychosocial health and well-being

What follows is a review of the recent literature relating to the benefits and risks of physical activity for psychosocial health and well-being, with particular attention being paid to the implications for girls and women. The literature review is organized according to the general relationship the psychosocial dimensions are considered to have with physical activity. That is, factors that have been shown to decrease with an increase in physical activity are described as “negative affect” factors and include stress, anxiety, depression and PMS. Those factors that have been shown to increase or improve with an increase in physical activity are described as “positive affect” factors and include self-efficacy, mood, cognitive functioning, well-being, and quality of life. The third group of factors are organized around negative outcomes related to physical activity and include exercise addiction, over-training and burnout. The review concludes with the consideration of specific populations including children and youth, older adults, ethnic minorities, and persons with a disability.

In general, clinical populations and the physiological aspects of psychological health will not be considered as they are beyond the scope of this review. Certain dimensions of self-concept (self-esteem and body image) will only be touched on briefly as they are addressed in Chapter 2.

Negative affect

a) Stress response

Psychological stress is important for living a full and challenging life, just as it is a secondary risk factor for major health problems. Stress in one part of life may influence individual ability to cope with stress in other aspects of life. When a psychological response is greater than needed for the situation, the response can be considered to be a stress reaction. According to Franks [23], stress has three major components: the response related to the task/situation requirement, the level of enjoyment, and the resulting development or deterioration. In order to determine whether a potentially stressful experience leads to better or worse mental, social and physical health, the eventual outcome must be considered in combination with the physical, emotional and social attributes, abilities and perceptions of the individual [23]. Franks [23] summarizes the important contribution stress makes to well-being:

> Stress, like fat, is good, yet too much or too little can have negative effects. Stress is an important element for understanding both positive and negative aspects of life. No discussion of the highest quality of life possible or of serious health problems would be complete without including the relevance of stress [23; p. 1].

Gill [24] reinforces the importance of individual perception by emphasizing that there is no stressor unless the individual perceives that there is. It is the perceived threat that elicits the stress response, often defined by psychologists as state anxiety [24]. However Gill [24] argues that stress is not one construct but a complex system of interrelated constructs and processes. There is a large body of literature that has investigated the relationship between anxiety and performance and competitive anxiety, although these particular areas will not be addressed here because they deal primarily with sport performance. Research on exercise adherence has also found stress to be a useful construct to explain exercise relapse [25]. However, what may be more relevant from a benefits for health perspective is the work that has been done in relation to exercise and stress. This area draws on health psychology and is not well developed. When physical activity has been considered in health psychology it is often related to the health-protective effects of exercise, or to the use of exercise as a coping mechanism in recovery and rehabilitation. The role of physical activity has also been assessed as a potentially negative influence on stress and health [24].

With respect to the protective effects of exercise, much of the literature related to stress considers both the physical and psychological aspects. Findings of both cross-sectional and longitudinal studies generally show that physical fitness correlates with a reduction in the physiological response to psychological stress [22], although the effect size varies from significant to negligible [3]. Research into leisure time physical activity has demonstrated a relationship between increased activity levels and decreased perceived stress [26]. Recent research has also considered the different effect between aerobic exercise and anaerobic strength training [27] with results that appear significant but are often not able to be replicated by other studies using similar measures [3].

> As a consequence, discussion often revolves around methodological concerns, and definitive conclusions remain elusive [3; p. 114].

The authors of a recent critical review suggest that at this time, exercise should be considered to be a preventive rather than corrective intervention as a result of the stress response being only partially understood with respect to both physiological and psychological [3].

However, some authors do recommend physical activity as a method of coping and managing stress, especially in the short term. Berger [28] identifies several attributes of physical activity that have been identified as contributing to positive stress management. These include enjoyment, aerobic exercise or rhythmic abdominal breathing, absence of interpersonal competition, and a closed or predictable activity [28]. In research comparing the effectiveness of exercise to other stress-management approaches, investigators have found that exercise is as effective in reducing tension, depression and anger as other techniques, although not more effective and often recommended to be used in combination with medi-

tation, progressive relaxation and stress inoculation training [28]. In a study with college students, researchers found that non-physical forms of leisure and recreation such as social and mass media activities were actually more effective than fitness activities at reducing perceptions of academic stress [29]. They suggest that more attention needs to be paid to other types of student stress and the relationship with different types of recreation and leisure activities [29].

The underlying mechanisms for improved stress response as a result of exercise have been theorized from a physiological perspective as being the result of improved physical fitness. Because both exercise and mental stress increase heart rate, blood pressure, adrenaline, and other biochemical measures, "hardening" the body by adapting to exercise stress can lead to better adaptation to mental stress [30]. However, the underlying psychological mechanisms are not as well understood, partly because of methodological issues that leave several key questions unanswered. These questions include the independent or joint effect of physical activity or physical fitness, and the measurement of psycho-physiological indicators of stress reactivity that are confounded with physiological measures used as independent variables (i.e., heart rate) [8, 26]. Some researchers have speculated that the subjective qualities of the environment, such as recreation in the park in comparison to the home, would enhance the restoration of positive mood and reduce stress. Unfortunately, a recent exploratory study was not able to confirm that recreation near nature is more restorative than recreation away from nature, although leisure at park settings did seem to produce a public benefit of stress reduction [31].

Research into psychological mechanisms related to physical activity and stress may also be limited by the use of stress models that do not include the social aspect of stress. Gill [24] suggests that using Lazarus's stress model will help us to recognize that stress is a biopsychosocial process, not simply psychobiological.

> Everything takes place within a social context. Social context affects both person and environment and determines both sources of stress and appraisals of stress. For example, sources and perceptions of competitive stress and coping processes may be quite different for girl and boy soccer players. Social context further influences psychophysiological responses and consequences of stress, as well as coping processes [24; p. 26].

And finally, in his discussion of the implications for research into physical activity and stress, Meier [32] suggests that not enough attention has been paid to the possibility that we may have too little stress in our lives to lead a full and vibrant existence. He argues that we should consider the implications of eustress (or positive stress) and stress-seeking behaviour for health and well-being. Instead of thinking of playful sport as an area of low stimulation, it could be considered as relatively high stress that contributes to the establishment and provision of a satisfying, stimulating and meaningful life.

> My point is that often there is too little, rather than too much, stress in our lives, and as professional practitioners in the field of sport and play, we have not explored this facet of the human experience sufficiently [32; p.142].

b) Anxiety

Anxiety can be understood as a physical and mental response to a perceived threat or stressful situation, and may result in the fight or flight reaction and related responses. As was noted above, state anxiety (or situation-specific) is often measured as a stress response [24], as opposed to trait anxiety which is related to individual personality. For example, what creates anxiety for one person may be perceived as a challenge by someone else.

Reviews of the benefits of physical activity for reducing anxiety generally conclude that exercise training programs are effective in reducing anxiety [33], particularly among those experiencing chronic work stress [3]. Researchers have also concluded that reduction in anxiety is probably not a methodological artifact [34], although this particular study was based on college males and no females were tested. The mechanism that contributes to the reduction of anxiety is not clear, although aerobic activity appears to

be more beneficial than anaerobic exercise [3]. Less intense exercise and the individual perception of a positive performance also appear to contribute to the reduction of anxiety [35]. There is a lack of consensus on the intensity and duration recommendations for exercise. Short bursts of exercise appear to be sufficient with the level of exertion being appropriate for the individual, although the link between fitness and decreased anxiety may only exist for chronic exercisers [36].

> As with depression, the most positive effects are noted among those who adhere to programs for several months [3; p. 113].

A number of underlying mechanisms have been suggested to explain the relationship between increased physical activity and decreased anxiety. Explanations that have received some support in the literature include: the expectation that anxiety would reduce as a result of exercise; exercise provides a time-out; social interaction; increase in self-efficacy; changes in weight and or appearance as a result of exercise, and various physiological and biochemical reasons [37, 38]. However, the majority of this research has been done on middle-aged white men.

> Although it seems likely that sociocultural factors might influence how women and men of different ages, education, race, or ethnicity perceive exercise, its outcomes, and its context, the current evidence does not permit conclusions about whether the association of exercise with anxiety and depression is consistent across demographic groups [14; p. 368-9].

Conclusions about the anxiolytic effect of exercise are also limited by methodological issues that have assessed anxiety as fluctuations in ratings of happiness or calmness, or using anxiety measures that reflect arousal [39] making the implications for mood disorders unclear. As well, the typical effect has been determined for healthy subjects with normal anxiety, making it difficult to clarify the implications for clinical populations [14]. While increased aerobic fitness does not seem to be necessary for reductions in anxiety disorders, researchers have not been able isolate the effects of fitness and have not adequately studied other forms of fitness such as strength [14, 40].

c) Depression

Symptoms of depression can range from mild to severe and may include depressed mood, a pervasive loss of ability to experience pleasure, a loss of interest in usually enjoyable activities, a loss of motivation, and changes in sleep, appetite, weight, energy, and motor activity. Cognitive dysfunction related to depression may include concentration problems, self-deprecation, and suicidal thoughts. These symptoms may be transient and disappear without treatment, or may persist and meet the standardized criteria for major depressive disorders (MDD) [41].

Recent surveys report that 20% of Canadians feel depressed some of the time, that women are more likely than men to feel depressed, that younger adults experience depression more often, and that people with higher levels of education and income report less depression [42]. From a clinical perspective, depression is the most common primary care psychiatric diagnosis, with a lifetime prevalence of major depression at about 5% for men and 10% for women [41]. Researchers generally agree that from a treatment perspective exercise has a moderate-to-large beneficial effect on mild-to-moderate depression [22]. In comparison, the potential for exercise to act as a preventative factor is unclear – a recent longitudinal study of midlife showed no increased risk of developing depression for exercisers and non-exercisers [43]. However, among clinical populations a sedentary lifestyle was found to be a strong determinant of depression [3]. In addition, the benefit of exercise for prevention and relief of depression appears to be equally strong for men and women as well as all age groups [44]. However, other demographic factors such as education, race, ethnicity, and socioeconomic status have not been adequately assessed [14].

There is some disagreement among researchers about the benefits of anaerobic exercise, and more research is necessary in this area [3]. No specific guidelines exist with respect to intensity and duration for aerobic exercise, although some researchers recommend 60-70% of maximal heart rate, for 30-40 minutes, 2-5 times per week in line with the earlier guidelines proposed by the American College of Sport

Medicine [41]. Limited evidence also suggests that aerobic exercise is the most effective, especially in combination with psychotherapy, and that regimens should extend over several months to yield the most positive effects [8, 3, 30].

As for stress and anxiety, the study of depression has some significant methodological issues that have yet to be addressed. Most studies have defined physical activity in a way consistent with the contemporary view of exercise, but have often not quantified exercise or fitness directly. As well, some studies require more sophisticated designs to assess this relationship [40]. As a result, many reviews have made inappropriate generalizations about physical activity or fitness [14]. This also has implications for dose-response issues which, according to Dishman [14], have been grossly understudied.

The mechanisms that are potentially responsible for the beneficial effect of exercise on depression have also not been adequately theorized or investigated [8, 38]. Potential psychological explanations include the potential for exercise to distract from a stressful stimuli, exercise as a form of mastery and a way of regaining control of one's body and life, or the benefit of social interaction as a result of exercising with a group. The major biological mechanisms include the effects of endorphins, brain monoamines such as dopamine and serotonin, as well as simply the increase in body temperature [14, 41]. Interestingly, increased aerobic fitness does not appear to be necessary for reductions in clinical depression, although the reasons for this are unclear [14].

d) Premenstrual syndrome (PMS)

Only a small number of studies have considered the potential benefits of exercise on premenstrual syndrome (PMS), although there is anecdotal evidence that exercise decreases negative symptoms commonly associated with PMS such as depression and anxiety [3]. Some studies have shown that exercise has a prophylactic effect on a range of physiological and psychological symptoms including appetite changes, breast tenderness, fluid retention and mood changes [3, 45]. The beneficial effect of exercise is further supported by research that found low exercise and sedentary groups have significantly more symptoms. However, highly active exercisers may not receive this benefit due to the potential for high levels of exercise to contribute to levels of stress [3].

It should also be noted here that excessive exercise, often termed "exercise abuse" has been associated with issues of reproductive health. Overly intense exercise has been associated with delayed menarche, menstrual dysfunction and cessation of menses, as well as premature bone loss [4, 45, 46]. This will be more fully explained in later chapters of this review.

While aerobic exercise has been shown to improve the negative mood associated with PMS better than anaerobic activity, the exact mechanisms responsible for the improvement of psychological function remain unclear [3, 9]. Because reaching aerobic capacity does not appear to be necessary to alleviate negative effects associated with PMS, increased maximal oxygen consumption does not appear to be a causative factor, leading researchers to question why aerobic exercise appears to be beneficial [3]. Other mechanisms that have been suggested include reduced estrogen levels, reduced body fat, increased glucose tolerance, and a balancing of endorphin levels [3].

> Although the evidence continues to point to the benefits of exercise for those who experience PMS, while less strenuous forms of non-competitive exercise appear most effective, the type of exercise, its duration, and length and in turn the reasons for improvement in symptoms still await clarification [3; p. 116].

Positive affect

Research on the relationship between increased physical activity and increased positive psychosocial factors is not well-developed in the literature. While some progress has been made in understanding exercise participation and the reduction of negative affect, "there has not been corresponding development of our understanding in terms of the relationship of exercise/fitness in developing positive affect (e.g., enthusiastic, active, alert)" [38; p. 132].

a) Self-efficacy

Self-efficacy can be understood as a mechanism of personal agency and refers to belief in one's own capabilities to organize and execute actions required to attain a given level of performance. Self-efficacy is situational, task-specific, and not a general trait [47]. While it is often used conceptually as an outcome of physical activity (as improved physical self-efficacy), it is also implicated in various mechanisms that explain the relationship between exercise and other psychosocial factors such as stress, anxiety, depression, mood and well-being. For example, dimensions of self-efficacy, as an aspect of self-concept, have been used in models to explain the relationship between exercise and enhanced self-esteem [8, 28, 48]. A positive effect has been demonstrated for physical activity on self-esteem, especially in relation to subdomains such as physical self-worth and with respect to children [8]. Although the connection between exercise and self-esteem has been established, the nature of the relationship, including the role of self-efficacy, has yet to be adequately explored [3, 48].

The mechanism to explain the positive relationship between physical activity, improved self-efficacy and improved health has been theorized as an outcome of generally improved mental health and other psychological and social factors that are determinants of health [33]. Self-efficacy has also been implicated in issues of control, where personal feelings of control during leisure are related to feelings of enjoyment and may lead to enhanced mental health [11]. The connection with mental health was also made in a study of the relationship between leisure and recovering alcoholic women that found the meaning of leisure changes during the recovery process, and this recovery is related to the process of regaining control over their lives and their leisure [49]. However, the authors make the point that the leisure constraints women experience in our society may have contributed to the feeling of lack of control and therefore to the onset of alcoholism [49].

The link with increased self-control has also been suggested for exercise [40], although a study of healthy lifestyle practices (including physical activity) found that lifestyle practices may not be related to health-locus-of-control [50]. Hoy [47] makes the point that perceived self-efficacy and locus of control are not the same phenomenon measured at different levels of generality.

> Beliefs about whether one can produce a certain action (i.e., perceived self-efficacy) are not the same as beliefs about whether actions affect outcomes (i.e., locus of control). In fact, the data show that perceived self-efficacy and locus of control bear little or no empirical relationship with each other, and moreover, perceived self-efficacy is a strong predictor of behavior, whereas locus of control is typically a weak predictor [47; p. 155].

Self-efficacy has also been theorized to contribute to personal empowerment, although this relationship has yet to be verified [47] and the implications for physical self-efficacy are not clear.

b) Mood state

A clear relationship between exercise and positive mood has been demonstrated in the literature [8, 3, 33, 42]. In a general survey, 79% of Canadians said they are happy all or most of the time. This finding is similar for men and women, although happiness does seem to be linked to higher income and levels of physical activity [42].

Most measures of mood have been assessed using the Profile of Mood States (POMS), which was validated for use in clinical populations but has been used extensively in exercise investigations with nonclinical groups. While this scale has been useful, it has only one positive mood subscale and does not conform to the typical two-dimensional aspects of mood of evaluation or pleasure (e.g., pleasant/unpleasant) and activation/arousal [8]. Mood has been used to investigate post-exercise feelings as well as psychological well-being, including measures of anxiety, self-esteem and self-efficacy. This research has found a generally positive relationship between physical activity and psychological well-being [8]. In a study of working men and women members of a health club, researchers found that in comparison to

colleagues who were not members, members had increased levels of physical well-being, healthy lifestyles, positive mood, job satisfaction and less absenteeism [51]. Men and women in this study had similar mood state measures, although due to the cross-sectional nature of the study and the self-selected, homogenous population, it is not clear if these findings are as a result of greater levels of physical activity, fitness or some other factor [51].

As for other dimensions of psychosocial well-being, the underlying mechanism to explain the relationship between physical activity and positive mood is not yet understood [3]. The diversity of results between studies suggests that gains in physical fitness may operate independently of mood and suggest it is possible to have fitness gains in the absence of mood effect and vice versa [3]. Overall, the research shows support for both aerobic and anaerobic exercise being associated with an elevation of mood state, although the diversity of results suggests that it is likely there are a number of underlying psychosocial, psychological, psychopharmacological, or psychophysiological mechanisms that are not yet understood [3].

c) Cognitive functioning

Cognitive functioning is a general term that can be understood to include intelligence, intellectual functioning, memory and imagination. Narrative reviews of this area of research suggest that there is some support for the increase of cognitive functioning due to exercise [8]. However, the relationship is still unclear and researchers will generally only agree that exercise may be associated with positive changes in selected aspects of cognitive functioning [22].

Factors that show the most promise include increase in imagination [30], measures of mathematical performance, acuity and reaction time, with greater effects noted for chronic exercise in comparison to acute exercise [8, 30]. Effect sizes have also been noted as greater for females than males [8] although the reason is unclear. It is possible that it could simply be the result of women being less active and therefore at a lower baseline before the exercise intervention. With respect to children, research has demonstrated mixed results with some reviews claiming the academic performance of school children showed no effect [8], and others suggesting that academic performance increases among children and youth [33]. Overall, there is the potential for exercise to influence selected measures of cognitive functioning, although both the results and underlying mechanisms are currently unclear.

d) Well-being and quality of life

As was noted in the introduction, the notion of well-being has often been equated with mental health, although the “emerging consensus among researchers is that the term ‘well-being’ implies an emphasis on the individual’s perception or sense of wholeness of self, groups or community” [2; p. 11]. Well-being is therefore individual and collective, multi-dimensional, and determined by subjective experience. It is closely linked to quality of life in that both concepts have an objective (personal characteristics, social stability, safety, etc.) and subjective component. However, “quality of life” tends to be used to include the social and structural factors that influence well-being, while “well-being” is generally considered to emphasize the individual perception of well-being. For purposes of this review, well-being and quality of life are used interchangeably as general terms.

With respect to psychological well-being in particular, it can be considered to be made up of a number of factors such as tension/relaxation, insecurity/confidence and dependency/self-sufficiency [8], in addition to the many other dimensions of psychological health discussed earlier such as self-esteem, self-efficacy, positive mood, and stress response [33]. In general, physical activity has been recognized as having a moderately favourable effect on psychological well-being [22] and perceived quality of life [52]. In fact, a sedentary lifestyle has been confirmed as a risk factor for experiencing poor day-to-day perceived health, especially for older subjects [53]. Research on perceptions of leisure opportunities and assessments of quality of life has shown that leisure values are significant and positively related to perception of quality of life [2]. However, there are very few studies that attempt to assess the relationship between physical activity and a more holistic conception of well-being. Well-being and quality of life are usually assumed by

researchers to be the ultimate outcome, but secondary to the main objective of improved physical and mental health [5].

In a national survey, 39% of Canadians ranked leisure activities as important to their satisfaction with life, with men and women reporting equal satisfaction [42]. The results also showed that those Canadians who are most active are also most likely to be satisfied with their social lives. With respect to loneliness, being active appears to be unrelated, although active people are more likely to be hopeful about the future. Men and women reported similar rates of optimism (66% are hopeful about the future all or most of the time), although more women and older women than men reported feeling lonely some of the time [42].

The mechanisms for explaining how physical activity contributes to general well-being and a positive quality of life have not been established. In a study of the relationship between sport and physical activity and feelings of well-being, researchers found that increased activity levels increased well-being but that this finding was significant for women only [54]. When other factors such as health status and involvement in social networks were included as controls the strength of this relationship decreased. The authors suggest that the length of time devoted to physical activity each day may be part of the reason it does not have a stronger influence. Other life circumstances such as unemployment, single parenthood, low socio-economic status may be more important for overall well-being. As a result, the authors recommend caution for any estimates that sport and physical activity involvement lead in a substantial way to increases in psychological well-being, although sport and physical activity should still be viewed as a means to relieve the stress and anxiety associated with living [54].

Some researchers speculate that physical activity in the form of sport helps to develop pro-social and moral behaviours. However, both positive and negative effects have been found for this relationship [22]. For example, research has found that cooperative game structures promote positive social behaviour with young children, while studies on sport competition indicate that it can increase feelings of group rejection [8]. For children and youth, the key seems to be the provision of quality, adult leadership that places a high priority on the development of prosocial or ethical behaviour in sport and physical activity settings [4].

Studies on exercise and youth delinquency have had positive results [33], although not all could be clearly attributed to the effect of physical activity and may be a result of using a psychoeducational approach in a recreation setting [55]. Some researchers suggest that although physical activity is not sufficient, in combination with other factors it can help to alleviate predisposing factors to youth crime [42]. The opposing argument suggests that sport legitimizes aggressive behaviour, although the relationship between sport aggression and aggression in other areas of life is not clear [8].

A recent sociological analysis suggests that the growing direct involvement of women in sport in and of itself represents an equalizing trend between the genders [56].

> (Regardless), any relationship between physical activity and prosocial behaviors is likely to be dependent on the quality of the experience and the social climate prevailing, such as leadership behaviors. Physical activity, therefore, can be viewed as a vehicle for the development of prosocial behaviors, but the determinants of such outcomes cannot yet be delineated [8; p. 295].

Negative outcomes

Unfortunately, increased levels of physical activity do not always enhance psychosocial well-being. In some cases exercise has been described as an addiction, the notion being that the mood-enhancing and analgesic properties associated with exercise are influenced by chemicals in the brain that are similar in effect to opiates [3, 41]. Recent research has supported this and suggests strong links between exercise addiction and eating disorders [3]. Related to this concept is the effect that withdrawal from habitual exercise can have on mood states, including increased anxiety, depression and restlessness [3]. Unfortunately, there is a limited amount of empirical research on this topic and considerable methodological differences between studies, both of which make comparison difficult [3].

It is not clear if the mechanisms underlying exercise addiction are based on psychological factors (such as personality), physiological factors (such as endorphin dependence), or some interaction between the two [3]. Some research suggests that exercise addiction has less to do with exercise per se than with other psychologic events occurring in the individual's life. Exercise in this case can be considered to be a coping mechanism that becomes a separate problem [30]. Regardless of the mechanism, compulsive exercise behaviour should be viewed as unhealthy because the outcomes may include injury, excessive fatigue and poor psychological health [8]. However, most of the research stresses that only a few individuals are compulsive about exercise [22], and suggests that it should be considered more as a clinical than public health issue [14]. Advocates of women's health may wish to argue this point due to the close relationship between eating disorders and exercise addiction, and the prevalence of both among girls and women.

Finally, some authors recognize over-training and burnout as possible negative health factors associated with exercise [30]. Symptoms of over-training are similar to depression and may include fatigue, an increased resting heart rate, frequent illnesses, sleep, appetite and mood disturbances, lack of energy, lack of ability to recuperate, irritability, feelings of helplessness, hopelessness and incompetence, loss of libido, weight problems and myalgia [30, 41]. Burnout is more a problem of mental fatigue than physical fatigue, and activities that were previously associated with happiness and fun begin to stimulate fear, anxiety, anger and depression. Anthony [30] suggests that this phenomenon is not infrequent in children's competitive sports, possibly as a result of the external pressures exerted by coaches and parents.

D. Specific populations

1. Children and youth

Currently 30% of children and youth in British Columbia are inactive, in comparison to 45% of the entire population [33]. Physical activity has generally been perceived as essential for the healthy growth and development of children and youth, and important to the establishment of lifelong, healthy physical activity patterns [4, 33, 57].

The National Center for Chronic Disease Prevention and Health Promotion in the U.S. recently published guidelines for school and community programs to promote physical activity with children and youth [57]. The recommendations are based on published research as well as consultations with agencies and organizations working in this area. However, the report admits that many of the policy recommendations are also based on behavioural theory, standards for physical education, exercise science, health education and public health practices.

> More research is needed on the relationship between physical activity and health among young people, the relationship between physical activity during childhood and adolescence and during adulthood, the determinants of physical activity among children and adolescents, and the effectiveness of school and community programs promoting physical activity among young people [57; p. 202-3].

With respect to the psychosocial benefits of physical activity for children and youth, the report notes that physical activity among adolescents is consistently related to higher levels of self-esteem and self-concept, and lower levels of anxiety and stress [Calfas & Taylor, 1994, cited in ref. 57]. For adolescent girls in particular, exercise may be an effective preventative measure for deterring mental illness by helping them to deal with body changes, feelings of insecurity and powerlessness through the provision of meaningful, goal-oriented experiences [4]. In research with adults, the underlying mechanisms responsible for the positive relationship between physical activity and these psychosocial outcomes have not yet been adequately established.

With respect to benefits for children and youth, research has demonstrated that the perception of benefits is positively related to increased physical activity among young people. These benefits may be related to psychosocial factors and may include excitement and having fun, learning and improving skills, staying in shape, improving appearance and increasing strength, endurance and flexibility [57]. Recent research

has also suggested that the motivation for girls may be somewhat different from boys in the physical activity settings. For example, it appears that motivational dimensions of girls' participation are integrally linked with self-perceptions, but not so strongly linked for boys [4].

An important part of the argument for the support of physical activity among young people has been the assumption that people begin to acquire and establish patterns of health-related behaviours during childhood and adolescence [Kelder et al., 1994, cited in ref. 57]. One of the mechanisms for this continuation of physical activity patterns into adulthood has been theorized to be a result of increased exercise self-efficacy developed in childhood fostering exercise self-efficacy in adulthood. However, this theory has only received partial support as exercise self-efficacy appears to be dynamic and likely to change with recent experiences [58], as well as with respect to the specific situation and whether barriers are perceived to be external or internal to the individual [59]. In addition, formal educational and recreational activities during childhood appear to have only limited influence on adult physical activity. This may be the result of the type of education provided (i.e., team sports), or because it is only engaged in for a short time.

> If this conclusion is correct, then physical education should focus on sustaining youth in active lifestyles and other interventions will be necessary to sustain adults in active lifestyles as they leave the schools [58; p. 1175].

With respect to psychological well-being, a recent study with high school students found that physical activity and well-being are positively associated, although the correlation was very small [60]. This correlation was also higher for males than females, and higher for non-whites than whites. The author suggests that this weak link between physical activity and well-being may be a result of social interaction, especially for females. This relationship may also be better understood by considering individual goals and strivings since physical activity may signify a larger goal for some and not for others [60].

The meaning of physical activity for adolescents has also been considered by researchers investigating how age, gender and ethnicity act as determinants of coping. In their study, Frydenberg and Lewis [61] found that males report using more physical recreation strategies than females, who use more seeking-social-support, wishful-thinking and tension-reduction strategies. The authors speculate that the reasons for these different coping strategies may be based on the fact boys have more organized sporting opportunities, that the culture supports the goal of fitness for boys while girls are encouraged to focus on body size and shape [61]. As well, sport is a recreational activity that requires the freedom to move from place to place which girls may feel they do not have [61]. These findings suggest that there may be differences in psychosocial benefits of physical activity for girls in comparison to boys, such that the social context of the activity provides less benefit for girls.

In general, existing research on the psychological dimensions of girls' physical activity participation is quite limited, and there is even less research on those girls from diverse racial and ethnic backgrounds or with disabilities [4]. Self-perceptions, including self-esteem, self-concept, self-confidence and perceptions of competence and self-efficacy, are strongly connected to motivated behaviour in physical activity settings for girls, and this relationship appears to be cyclic, meaning, the better one feels about one's self and abilities, the more those perceptions are enhanced. As well, the role of significant others is critical in positively affecting this cycle [4]. It also appears that physical activity can have a protective effect for the mental health and well-being of girls. However, participation in excessive levels of exercise can have a negative effect on emotional well-being, including increased stress and anxiety for girls who are involved in highly competitive physical activities [4].

From a sociological perspective, research has suggested that physical activity is an important part of creating a gendered self, which is crucial to a child's sense of social competence and psychological well-being [4]. In this regard, physical activity may be both positive and negative, depending on the social experience, which tends to be magnified in adolescence when sharp declines in self-esteem, academic performance, athletic involvement and positive body image have been reported [4].

> In short, the social status of adolescent girls often depends on conformity to the feminine stereotype and the intensification of gender difference [4; p. 40].

Ethnicity also influences the experience of physical activity, with girls of colour significantly less likely to participate in organized sports and significantly less likely to receive encouragement from their parents to engage in athletic and fitness activities than white girls. However, with respect to vigorous physical activity, this does not appear to be true for boys [4].

2. Older adults

It has been shown that regular physical activity is important throughout the life cycle. In old age, exercise contributes to the conservation of physical function and the improvement of quality of life [33, 39, 62, 63]. Despite this, older women are among the least active populations [42], and with respect to life expectancy, physical activity has very little influence for middle-old (75-85 years) and very old (greater than 85 years) adults. The survival curves for active and sedentary individuals converge at around 80 years of age, and in the oldest age categories the physically active person may actually have a slightly shorter life expectancy.

> Thus, an active lifestyle helps a person avoid the final 8-10 years of partial disability and one year of total dependency that seem the norm for a sedentary individual [63; p. 300].

Physical activity for older adults has been attributed to maintaining an adequate level of function in order to sustain the activities of daily living and allow them to conserve independence and avoid institution-alization. It is assumed that the maintenance of functional independence supports positive well-being. Research also shows that, on occasion, regular exercise can reverse deteriorating mental function, “although it is unclear whether the mechanism is an improvement of cerebral circulation, an avoidance of small strokes, or merely a maintenance of an overall interest in life” [63; p. 299-300]. In addition, group exercises have been shown to provide the social support that an older adult requires when experiencing a sudden change in personal circumstances such as in the loss of a spouse or child or other caregiver [63], as well as an outlet for tension and self-expression [64].

With respect to older women specifically, there has been very little research on the potential of exercise to replace or supplement hormone replacement therapy related to perimenopausal conditions such as obesity, diabetes mellitus, depression and osteoporosis [63]. In general, there has been very little literature on physical activity and psychological well-being that involves older adults. “The evidence for psychological benefits of exercise for older adults is particularly limited” [24; p. 367], although aerobic exercise has been shown to improve negative mood associated with menopause [9, 45]. A study of exercise intensity and older adults found that although men exercised more intensely than women, intensive practice of physical exercise was related to better self-rated health, lower occurrence of depressive symptoms, and higher self-rated meaningfulness of life for both men and women. However, the authors admit that positive psychological health makes it possible to exercise intensely; therefore a causal relationship cannot be determined [65].

In some ways, the psychosocial well-being of adults improves as they age, with more older adults reporting that they are satisfied with life and are optimistic. However, more older women than older men report feeling lonely some of the time [42]. Although the literature demonstrates a positive association between physical activity and well-being for older adults [39], research is limited by the lack of standard measures of both well-being and physical activity that are relevant for older adults [62]. In a recent study of active and sedentary older women living independently and in residential housing, the authors found that physical activity and psychological well-being was not correlated with age at all. However, the study did find that the women who reported greater activity also reported more positive well-being [62]. The researchers suggest that because even general ratings of well-being such as health, concentration and sense of confidence were positively related to activity, the benefits of an active lifestyle may extend beyond specific physical measures [62]. However, these results are contrasted by an earlier study of customary or habitual physical activity that found activity failed to significantly predict levels of morale or

mental health for women, although it did for men, when medical and demographic factors were controlled [66].

The mechanisms underlying the relationship between physical activity and psychological well-being of older adults are not well understood. Some authors have suggested that self-efficacy, including fall-related efficacy and efficacy with respect to barriers, may be a key mediator for exercise and health behaviour in older adults [62, 67]. A study on the relationship between leisure activities and the psychological well-being of older adults found that those adults with a greater repertoire of leisure pursuits appeared to have higher levels of psychological well-being and less frequent occurrences of depression [68]. Interestingly, it was the passive activities such as crafts and hobbies rather than active or social pursuits that were most significantly related to higher well-being and lower depression. This suggests that personal outcomes of activities and the meanings associated with them may be more important than the activity level in the enhancement of well-being, although other factors such as income, education, health status, ethnicity, place of residence and life circumstance were not examined. The results of this study also suggest that the relationship between leisure participation and well-being is a reciprocal one, rather than unidirectional and linear as has been proposed [68]. These results may also help to explain why a leisure education program designed to enhance the psychosocial well-being of home-centred older women found that leisure participation increased, but various measures of psychosocial well-being (boredom, loneliness and depression) were not affected [69].

In a recent study on aerobic exercise, subjective health and psychological well-being, the researchers found that active older adults were more likely to be invested in their physical activities and therefore report better subjective health, in comparison to active younger adults [70]. With respect to gender differences, women were significantly more likely than men to report better subjective health when they engaged in walking for exercise. The authors suggest that this study demonstrates that "the psychological benefits of action often are the greatest when the individual distinguishes himself/herself from normative patterns. Behaviour which is easy because of social acceptance or approval is not necessarily the most profitable" [70; p. 1559].

3. Ethnicity

Throughout this discussion, issues of race and ethnicity have seldom arisen, and when they do it is usually only as a controlled variable in cross-sectional data. The greatest amount of literature with respect to the relationship between physical activity, psychosocial well-being and ethnicity deals with issues of participation and exercise adherence. For example, in the U.S., black women and girls are much less likely to be physically active than their white counterparts, regardless of age and socioeconomic status, even though the effects of ethnicity tend to be confounded by socioeconomic status as visible minorities are also more likely to be low-income [4, 71]. The social and cultural implications for the benefit of physical activity to visible minorities in North American society, or for the application to other cultures of psychosocial constructs developed in Western research and used to assess the benefits of physical activity, have not generally been investigated.

> While some hypotheses may stand the test of cross-cultural validation, others may be more culturally dependent, but testing for them is no doubt advantageous to theory building [72; p. 167].

Researchers investigating the relationship between leisure patterns and well-being for older adults in Taiwan found that physical activity shows the strongest relationship for the benefit of the health and well-being of both men and women [72]. However, in contrast to findings in the West, social leisure is not beneficial to the well-being of older women. In general, older Taiwanese women are not active in physical, creative or social recreational pursuits, preferring contemplative activities (worshipping and thinking). Unfortunately, this study found that these contemplative activities for women were negatively related to well-being, even though this is the most common leisure activity. The authors speculate that the social role of women in Taiwan does not involve engaging in free-time pursuits to the same degree as men, possibly because they are involved in the instrumental tasks of maintaining the house and therefore have little opportunity to pursue personal leisure [72].

> The positive influence of physical activity supports the notion of the beneficial aspects of activities which promote feelings of self-efficacy. Hence, although the results only partially confirmed hypotheses developed in the West, previously developed theoretical orientations were found to be useful in speculating on the causes of some of these divergences [72; p. 184].

In North America, few studies have considered the social and cultural implication of ethnicity for psychosocial well-being. For example, although stress is an important determinant of health and well-being, and increased levels of physical activity are related to decreased levels of stress,

> few researchers have emphasized the specific issues of stress and psychological well-being as they relate to African American women …(or) attempted to integrate theoretical concepts of stress with concepts of ethnicity and culture [73; p. 184].

Epidemiological studies suggest that black women in the U.S. experience greater morbidity and mortality from stress and stress-related disease than do white women, although the relationship between skin colour and stress has not been firmly established because it is confounded by socioeconomic factors [73]. Contributing factors to the increased amounts of stress black women face seem to be related to institutional racism and ethnocentric practices of the dominant (white) culture, and the stresses that often accompany poverty [73].

It has been demonstrated that black women in the U.S. do not see themselves exclusively or primarily as victims and show resistance and strategies for survival. Research shows that they tend to cope by using prayer, facing the problem directly, keeping busy and seeking help through an informal network [73]. Jackson and Sears [73] propose that these coping strategies could be supported by using an Africentric worldview to provide an appropriate and positive framework for appraising the experiences of African American women. This view would be based on seven principles: culturally relevant knowledge of self which can be empowering; a positive framework and therefore a more positive reaction to an oppressive society; a high level of self-consciousness leading to effective psychological functioning; a unifying philosophy that results in a sense of security; valuing people simply because they exist; group orientation leading to social support; and living in the moment [73].

The authors discuss several implications for counseling practice that result from this perspective [73]. However, implications for the relationship between physical activity and stress can be imagined based on the fact that culturally and socially based beliefs and values about physical activity have the potential to influence how activity is related to the experience of stress for black women. For example, exercise in a group of similar women may result in greater psychosocial benefits due to the cultural emphasis on social support. Exercise that incorporates spiritual elements, such as tai chi and yoga, may also have a differential influence on positive well-being by supporting a unifying and in-the-moment experience. Traditional aerobic exercise classes that motivate using negative feedback may be experienced as damaging rather than encouraging, in spite of the feelings of challenge and accomplishment that they are designed to elicit. Although these ideas are speculative, they emphasize the need to consider underlying social and cultural beliefs, attitudes and values in order to assess the relationship between physical activity and psychosocial well-being. The authors of this article conclude by saying that although their focus was on African American women, “the ideas presented may be applicable to other groups of people and thus can be beneficial in a broader multicultural context” [73; p. 189].

4. Disability

Although the literature on the rehabilitation benefits of exercise and the development of competitive sport for people with disabilities has been increasing, the majority of the research has considered the physiological effects of exercise and has left the psychological implications relatively underdeveloped [74]. The progress that has been made is generally in the area of using sport and exercise to help individuals cope with physical disabilities, or in the area of psychological benefits of sport for wheelchair participants [74]. The benefits that have been described are similar to those for able-bodied participants, including enhanced self-esteem, better mood, and lower anxiety levels [74]. Unfortunately, most of these studies have compared wheelchair athletes with able-bodied athletes, rather than wheelchair sport non-participants.

When participants have been compared to non-participants, the results show that participants had more positive mood and higher physical self-efficacy [75]. In contrast however, a study with male wheelchair basketball players and non-participants, all of whom had acquired their disability rather than been congenitally disabled, found that participation did not associate with a different mood profile, although participants did have significantly lower levels of depression than wheelchair sport non-participants [76]. Unfortunately, these findings are inconsistent and under-represent women.

In a more recent study, researchers found that individuals with disabilities who participate in sport have higher levels of psychological well-being when compared to non-participants, although women were under-represented, making up only 22% of the wheelchair sport participants [74]. The factors that contributed to well-being in this study included mood state, mastery, physical self-efficacy, and perceived psychological well-being. Mixed results were found for fatigue which was similar for both participants and non-participants, anger which was higher for participants, and mood which was variable within participation groups. Campbell and Jones [74] conclude that participating in sport, whatever the competitive level, causes a more positive mood and greater self-perception of health and well-being, although the level of competition does influence trait anxiety, self-esteem and mastery. However, further research is necessary to consider the implications of the cause and severity of the disability, the influence of the competitive level of sport, the mechanisms that explain the relationship between participation and improved well-being, and whether gender influences the benefits of participation for psychosocial well-being.

There is also a need for more research with respect to the benefits of physical activity for people with disabilities other than mobility disabilities, such as developmental disabilities. For people with mental retardation and other development disabilities, there is a comparatively smaller body of information about physical activity and well-being, particularly with respect to aging [77]. Different mental disabilities show different aging patterns. For example, mental retardation caused by Down's syndrome is characterized by a shorter life expectancy and earlier onset of age-related decline. There are also significant differences between men and women with Down's syndrome, where women physically peak later than men [77]. In a study of leisure patterns and the evaluation of life satisfaction, satisfaction was significantly related to participation in leisure activities, influenced by the age of the individual [Hawkins et al., 1992, cited in ref. 77]. In a second study on the psychological functioning of people with developmental disabilities who are aging, the author found leisure activity to help with adaptation to the aging process [77]. However, most of the research related to the benefits of physical activity for the well-being of developmentally disabled adults, and the risks of a sedentary lifestyle, has focused on the physical functional status rather than psychosocial benefits [77].

There has been some research on the relationship between physical activity and psychosocial well-being for women with fibromyalgia and chronic fatigue syndrome (CFS), both of which are chronic and physically disabling conditions with a psychological component, and affect primarily women [78-80]. Most of this research is found in the rehabilitation literature rather than the disability literature. With respect to fibromyalgia, a recent study confirmed earlier studies, finding that aerobic exercise appears to be an effective treatment when patients adhere to it [80]. Stress management treatment also proved to be effective in the short-term but not in the long-term, although it did show better long-term compliance [80]. There are very few studies on the relationship between fatigue and physical activity in CFS. In general, studies have found that patients who were physically inactive had higher fatigue levels than those who were more active, with one study suggesting a causal effect [79]. Compliance also appears to be a problem with respect to physical activity and CFS as it is for fibromyalgia. In both cases, beliefs that the disability is related to physical causes and that activity is therefore harmful and will lead to fatigue are common, suggesting that cognitive processes are important for assessing the perceived benefit of physical activity for these individuals [79, 80].

Finally, the experience of disability for women needs to be considered in order to understand their relationship with physical activity and psychosocial well-being. In a review of wellness and sexuality issues for women with physical disabilities, Nosek [81] describes the notion of wellness in disability as an operating principle for supporting women's health. When disability is equated with illness the associations

made with illness are brought in, associations such as being exempt from normal responsibilities, not being expected to be productive, being a victim, and expectations to comply with orders of experts. “For women, this has the effect of neutralizing their femininity (and) creating the perception they are gender-free” [81; p. 166]. Nosek [81] argues that using a wellness model that emphasizes the role of harmony, the sense of coherence, self-control and competence, the importance of resilience, and the integration of a lifestyle that is personally appropriate, will support the well-being of disabled women.

With respect to physical activity, women in this study demonstrated that those with positive self-worth valued their health and considered exercise as a way to preserve it [81]. However, these women also found exercise and health care facilities were generally inaccessible, there was a lack of information available on how to stay fit, there was a lack of adequate support services such as transportation and personal assistance, and a lack of health insurance to cover preventive measures [81]. Although this study did not address the question of how physical activity can benefit psychosocial well-being, the problem of social, cultural and structural barriers to participation were clear. Even if the physical benefits of exercise for women with a disability were clear, this study raises questions about how physical activity could contribute to general well-being in light of the barriers that must be faced every day. It seems likely that the psychosocial benefits of physical activity for people with disabilities will not be realized until there is social change.

> As far as policy makers are concerned, the change in perspective – from person-centred to situation-centred – is of fundamental importance. The way a social problem is defined determines the way policies are written, strategies for change are selected, social delivery systems are designed and implemented, and criteria for evaluation are considered [81; p. 179].

E. Summary

So what do we know about the benefits of physical activity for the psychosocial well-being of women and girls? We know that in general, physical activity has a beneficial effect on mood, cognitive functioning and psychological well-being. Exercise is also related to a decrease in levels of anxiety, depression, and psychological stress. For women, exercise has been shown to improve negative mood associated with PMS. Regular physical activity appears to be especially important for girls, as it supports the development of a positive self-concept and contributes to general health. For older women, habitual physical activity helps maintain functional capacity and sustain a positive quality of life into old age. However, physical activity can be damaging to individual well-being through factors such as exercise addiction, over-training and the experience of social pressure on women that constrains their exercise and leisure activity.

F. Gaps in the Literature

Unfortunately, what we do not know about the benefits of physical activity for psychosocial health makes a much longer list. We do not know the nature of the relationship between physical activity and the various dimensions of psychosocial well-being other than it is generally positive. Studies have reported a number of effect sizes, from negligible to significant, for a range of physical activities (aerobic and an-aerobic exercise, sport, leisure, habitual and daily activity), in relation to a number of psychological and social health constructs (stress, anxiety, depression, self-esteem, self-efficacy, locus of control, prosocial behaviour, violence, aggression, mood state, well-being, etc.), measured using a variety of scales and research methods (cross-sectional, longitudinal, questionnaire, biophysical measurement, interviews, observations, etc.), and involving predominantly white, middle-class, able-bodied, male research participants. As a result, there has been a great deal of speculation as to size, direction, and causal mechanisms related to the general finding of the benefit of physical activity for positive well-being, especially among girls and women.

Initially, this state of affairs may feel overwhelming to those researchers, advocates and policy makers trying to support the health and well-being of women and girls, especially for those who have experienced the benefits of an active lifestyle and feel intuitively that the benefits are far greater than we have been able to measure so far. However, there are some promising directions in the research at this time. The most interesting appear to be related to the individual as an agent of change (self-efficacy, personal

control, stages of change) and the inclusion of social theories in multidisciplinary investigations (social status, power and empowerment, capacity).

G. Implications

1. Research recommendations

There are several research directions that show significant potential for helping to understand the relationship between physical activity and psychosocial well-being. At the most specific level of psychological dimensions of mental health, the research base remains thin, with a significant need for more primary data collected on a large scale using multidimensional constructs [3]. This would most likely be in the form of longitudinal research using standardized measures for physical activity, identified constructs of psychological well-being, with good controls for modifying variables. The results of these types of studies would most likely help to explain psychological-physical interaction [3], as well as clarify the relationship between physical activity, well-being and life stage, particularly the link between childhood and adulthood physical activity behaviours [4].

However, this type of research is likely to be hampered by inadequate theorization about the mechanisms that mediate the relationship between physical activity and holistic well-being. Work needs to be done to explore various explanatory theories more closely, although the complexity of the relationship makes it unlikely that one theory or model will explain these mechanisms [3]. In fact, some researchers suggest that it would be more beneficial to investigate the relationship between physical activity and psychosocial well-being for a diversity of populations before attempting to explain the underlying mechanisms [28]. Since there has been a serious lack of research on girls and women in general, as well as marginalized populations such as low-income, visible minority, and women with disabilities, a more inclusive research agenda has the potential to make a significant contribution to the well-being of girls and women [4], as well as to the understanding of the benefits of physical activity for everyone.

Some of the most promising psychosocial constructs for understanding the relationship between physical activity and well-being have been concepts such as self-efficacy (physical self-efficacy, efficacy with respect to barriers and falls), personal control, and stages of change theory. These concepts are often theoretically linked to social theory through ideas such as human agency, social status, empowerment, and individual and community capacity. This linkage underscores the potential for an interdisciplinary perspective, incorporating quantitative and qualitative research from a variety of research traditions (exercise science, psychology, sociology, women's studies, education, social work, health promotion), to make a significant contribution to our knowledge. More research needs to be done following the principles of interdisciplinary investigation [4].

The idea of interdisciplinary research has received additional support in the health promotion and leisure literature with the development of ecological and wellness systems models that consider, on the one hand, the need for balance between different dimensions of wellness that may be unique for each individual [13], and on the other, the need for an ecological interdependency and balance between the individual and the environment [82].

Finally, there is a need for research that considers the development and implementation of specific interventions to support the psychosocial well-being of girls and women. Exercise adherence research has demonstrated that intensity influences the probability of maintaining regular physical activity. More research is needed to quantify this relationship, especially with respect to specific populations. Evidence is also available that demonstrates programs tailored for specific populations are likely to be more effective [3], possibly because they consider the situational factors such as social support, environmental safety and cultural implications. There is a need for more situation-specific (person-situation interaction) research with serious attention to the "positive" in activity and leisure experiences [11].

Suggested research questions

1. Do women who were active as children continue to be active as adults, and is this activity related to physical and psychosocial health throughout the life cycle? How does this relationship change when women who were not active as children are considered?
2. What tools and techniques are most appropriate for evaluating physical activity in the daily lives of women?
3. What theoretical models, tools and techniques are most effective for understanding and evaluating the complex and multi-disciplinary concepts of psychosocial health and general well-being?
4. Do women and girls who are marginalized in our predominantly white, middle-class, heterosexual and able-bodied society experience the relationship between physical activity and psychosocial health in different ways?
5. What is the role of empowerment and sense of control in the relationship between physical activity and well-being?
6. Considering situational factors such as social support, environmental safety and cultural norms for girls and women, does the "quality" of the experience of physical activity influence the perceived (subjective) and objective benefits to psychosocial health and well-being?

2. Policy recommendations

While there is a range of policy options that would support the participation of women and girls in physical activity in order to enhance their psychosocial well-being, recommendations would be most useful if targeted toward specific populations, settings and health outcomes. Due to the overview nature of this report however, it is perhaps most appropriate to emphasize the general principles that could enhance effective policy development in general. Based on the research with respect to the benefit of physical activity for the well-being of girls and women, there are three basic principles that appear to be important for the development of effective social policy:

Participation opportunities: Research on current participation levels has provided useful benchmarks for assessing the impact of policy and program changes on the involvement of girls and women. This type of information-gathering needs to continue in order to support the development of new policies and programs. However, these measures currently have inadequate representation of sub-populations and measures of community capacity, health and well-being. In addition, policy makers need to consider not just the number of opportunities that are available for girls and women to be active, but also the quality of these opportunities [4].

Tailored programming: There is a need for programs, facilities and environments to be tailored for each distinct population of girls and women. Research has demonstrated that groups defined by gender, age, activity levels (active, sedentary), readiness for change (contemplation, action, maintenance), socioeconomic status, and ethnicity have different needs and capacities and are therefore best supported using different strategies.

Community partnerships: The literature on the implications of physical activity for general health and well-being, as well as the enhancement of the psychosocial health of girls and women, overwhelmingly supports the need for community partnerships at all levels [4, 22, 33, 57]. The factors that contribute to well-being are multidimensional and interdependent and thus require a strategy that reflects this in order to be effective.

H. Search Strategies

Two databases were used to locate the majority of the literature on the relationship between physical activity and the psychosocial dimensions of health and well-being. These were the Articles First, and the Humanities and Social Sciences indices. Articles published from 1990 were selected for review. The dominant psychosocial key words grouped by related topic included:

- stress, tired and fatigue

- mental health, anxiety, happiness and depression
- control, personal control and self-efficacy
- well-being, wellness, and quality of life

The key words for physical activity included: physical activity, exercise, leisure, recreation, active living, lifestyle, sport and fitness.

Articles dealing specifically with women and girls were located using the key words: girls, women, female and gender.

Finally, diversity was ensured by searching with key words grouped by related topic and included:
- age and disability
- race, ethnic and culture
- sexual orientation, gay and lesbian
- single parent, family, parental status and marital status
- employment, unemployment, education, socioeconomic status and income
- rural and urban

Other sources were located using references and bibliographies of related articles and reports. Although it would have been preferable to use only sources that investigated the benefits of physical activity for girls and women specifically, the lack of psychosocial research targeted directly at this area made it necessary to consider the broader research base in order to investigate the implications for women and girls. As a result, some areas, such as for persons with a disability, refer to research that has been done primarily on men and therefore take a largely theoretical perspective in the discussion of implications.

I. Literature Summary Tables

The following tables organize the literature reviewed in this report according to the type of research and/or topic. Only those articles that are specifically related to psychosocial health and well-being, and physical activity are included. Papers and reports that deal with the health status, participation in physical activity, and the social and cultural context of women and girls in our society can be found in the references section only. The key words for physical activity, health and diversity include those noted by the authors, as well as those implied in the article itself.

Table 1. Summaries, reviews, meta-analyses

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
1997 Physical Activity Benchmarks Report [42].	• physical activity	• health • perception of positive health • weight • depression • stress • happiness • satisfaction with life • loneliness • optimism • youth crime	• age • gender • education • income
Anthony, J. [30] Psychologic aspects of exercise.	• exercise -cardiovascular fitness -strength -flexibility	• depression • anxiety • mood states • self-concept • intelligence	• general
Berger, B.G. [28] Coping with stress: the effectiveness of exercise and other techniques.	• exercise	• stress management • psychological stress • mood enhancement • self-concept • self-esteem • stress reactivity	• general • demographic diversity weak
Biddle, S. [8] Exercise and psychosocial health.	Meta-analysis of: • exercise • habitual physical activity • aerobic fitness training • sport	• psychosocial health • psychological and social-psychological outcomes • mental health: -high self-esteem -positive mood -reduced anxiety and depression -cognitive functioning -stress reactivity • negative psych effects of exercise	• age • healthy people
Brehm, B.A. & Iannotta, J.G. [9] Women and physical activity: active lifestyles enhance health and well-being.	• lifelong and regular physical activity • exercise • enjoyable physical activity • strength training	• disorders -heart disease -diabetes -osteoporosis -cancers • weight control • functional independence • mental health -psychological well-being -depression -body image	• women and girls • socioeconomic background • lifecycle
Crose, R. et al. [13] Gender and wellness: a multidimensional systems model for counseling.		• wellness: -physical -emotional -social -vocational -spiritual -intellectual	• gender issues

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Dishman, R.K. [14] Physical activity and public health: mental health.	• physical activity • exercise • not sport	• depression • anxiety	• men and women • demographic diversity weak
Dunning, E. & Maguire, J. [56] Process-sociological notes on sport, gender relations and violence control.	• sport	• violence	• gender relations • gender identities
Frankish, C.J. et al [2]. Active living and mental health.	• physical activity • exercise • active living	• mental health	• general
Franks, B.D. [23] What is stress?	• physical activity	• stress definition	
Gill, D.L. [24] A sport and exercise psychology perspective on stress.	• exercise • sport	• cognition of stress • biopsychosocial process	
Haworth, J. [11] Leisure and categorical models of mental health.	• leisure	• psychological and social benefits • life satisfaction • wellness • health	• not specifically addressing women
Heart Health Coalition (1997). [33] BC – Setting the pace: a plan to improve the health of British Columbians through physical activity.	• physical activity • inactivity • physical education	• cardiovascular disease • disease prevention • health enhancement • economic impact	• population of BC • target groups: -children and youth -adults -seniors
Landers, D.M. [38] Performance, stress, and health: overall reaction.	• physical activity	• stress	Summary of special review publication
Lenskyj, H. [6] Women, sport and physical activity: selected research themes.	• physical activity • sport • exercise		• women • girls
Lenskyj, H. [45] Women, sport and physical activity: research and bibliography (2nd ed.).	• physical activity • sport • exercise		• women • girls
Locke, L.F. [83] Implications for professional preparation and practice.	• physical activity	• stress research	
Meier, K.V. [32] Physical activity and stress: the road not taken and the implications for society.	• physical activity	• stress	
Nicoloff, G. & Schwenk, T.L. [41] Using exercise to ward off depression.	• aerobic exercise (low and high intensity)	• depression (mild to moderate) • prevention of depression	• general
Physical activity, health and well-being: an international scientific consensus conference. [22]	• physical activity (habitual, regular) • inactivity • sedentary	• health • musculoskeletal • functional capabilities • cancer and immune function • psychosocial health • life stages	• age • men • women (only somewhat)

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Romans, M.C. [84] Physical activity and exercise among women.	• physical activity • exercise	• health • disease prevention • health promotion	• women
Schlicht, W. [10] Mental health as a consequence of physical exercise: a meta-analysis.	• exercise • physical activity	• mental health: -mood -subjective well-being -self-esteem -coping -life satisfaction -emotional states (anxiety, happiness)	Meta analysis: • 1980-1990 • 39 studies • 8,909 subjects • no clinical samples
Scully, D et al. [3] Physical exercise and psychological well being: a critical review.	• exercise	• psychological health -depression -anxiety -stress -mood state -self esteem -PMS -body image -exercise addiction and withdrawal	• general
Shephard, R.J. [63] Physical Activity, health and well-being at different life stages.	Importance of physical activity through the life cycle	• quality of life • health • health habits • risks/benefits	• age • some gender (perimenopause)

Table 2. Research papers – general and adults

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Aldana, S.G., et al. [26]. Relationships between leisure time physical activity and perceived stress.	• physical activity • leisure	• perceived stress • health status	• 32,229 working adults • mean age 37.3 • women 57% • Caucasian 83%
Bartholomew, J.B. & Linder, D.E. [35]. State anxiety following resistance exercise: the role of gender and exercise intensity.	• resistance exercise	• state anxiety	• 20 undergraduate students • gender -10 men -10 women
Brandon, J.E. & Loftin, J.M. [40]. Relationship of fitness to depression, state and trait anxiety, internal health locus of control, and self-control.	• fitness level	• emotional states: -depression -health locus of control -state-trait anxiety -self-control	• gender: -8 women -9 men
Cooper-Patrick, et al. [43]. Exercise and depression in midlife: a prospective study.	• self-reported physical activity	• depression • psychiatric distress	• 752 physicians -92% men -8% women
Daley, A.J. & Parfitt, G. [51]. Good health – is it worth it?	• physical activity	• mood states • physical well-being • job satisfaction • absenteeism	• 293 employees -men 147 -women 146 • aged 18-63
Henderson, K.A. & Gardner,	• leisure	• addiction	• 9 recovering alcoholic

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
J.M. [49]. Claiming control: the recovering alcoholic woman and leisure.			women
Hull, IV, R.B. & Michael, S.E. [31]. Nature-based recreation, mood change, and stress restoration.	• recreation (indoor and outdoor)	• stress • mood	• 108 adults in outdoor study -48 men -60 women -average age 22 • 20 adults in indoor study -10 men -10 women
Jambor, E.A., et al. [37]. Association among fitness components, anxiety, and confidence following aerobic training in aquarunning.	• fitness • aquarunning	• anxiety • confidence	• 30 adults -15 exercising -15 not exercising • mean age 29 • gender not specified
McAuley, E., Mihalko, S.L. & Bane, S.M. [48]. Exercise and self-esteem in middle-aged adults: multidimensional relationships and physical fitness and self-efficacy influences.	• exercise • fitness • aerobic exercise	• global and domain specific self-esteem • body composition • fitness • self-efficacy • physical self-worth	• middle aged adults • previously sedentary but healthy • mean age 54.5 • 41 men • 42 women
McAuley, E., Mihalko, S.L. & Bane, S.M. [85]. Acute exercise and anxiety reduction: does the environment matter?	• exercise environment	• state anxiety	• 34 undergraduate students -16 men -18 women
McTeer, W. & Curtis, J. [54]. Sport and physical activity and subjective well being: national panel data for the U.S.	• sport • physical activity	• well-being feelings	• men • women • age 20-64
Norris, R., Carroll, D. & Cochrane, R. [27]. The effects of aerobic and anaerobic training on fitness, blood pressure and psychological stress and well-being.	• fitness	• physiological well-being • psychological well-being: -stress -mastery -self-efficacy -group dynamic effect	• 100 male police officers • aged 20-50
North, T.C., et al. [44]. Effect of exercise on depression.	• exercise	• depression	• general
Petruzzello, S.J. [34]. Anxiety reduction following exercise: methodological artifact or “real” phenomenon?	• aerobic exercise	• depression • anxiety	Study #1 • 18 men • age 21.8 Study #2 • 20 men • age 22.8
Ransford, H.E. &	• aerobic exercise	• subjective health	• 3025 adults

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Bartolomeo, J.P. [70]. Aerobic exercise, subjective health and psychological well-being within age and gender subgroups.		• psychological well-being	• age 20-64 (lifecourse) • gender • education
Schank, M.J. & Lawrence, D.M. [50]. Young adult women: lifestyle and health locus of control.	• lifestyle practices	• health locus of control (HLC)	• 76 women -38 nursing students -28 non-nursing students • mean age 24.5 • 82% single • 92% Caucasian • 80% employed • 84% lived with others
Sedlock, D.A. & Duda, J.L. [36]. The effect of trait anxiety and fitness level on heart rate and state anxiety responses to a mental arithmetic stressor among college-age women.	• cardiovascular fitness	• trait anxiety • stress	• 300 college women
Stetson, et al. [25]. Prospective evaluation of the effects of stress on exercise adherence in community-residing women.	• exercise	• stress	• 82 women who exercise regularly and are healthy • demographics predominantly: -Caucasian -middle-class -well-educated -middle-aged -normal weight -single, no young children at home
Unger, J.B. [53]. Sedentary lifestyle as a risk factor for self-reported poor physical and mental health.	• physical activity • recreational physical activity	• perceived physical health • mental health • restricted activity	• 3610 adults -56.5% women -43.5% men • average age 44.6 -age range 18-93 • ethnicity: -77% white -11.3% other -7.1% Asian/pacific -6% black -1.5% native • 60.2% employed • 16.2% retired • median education 1-3 years of college • median income $25 - 35,000
Woodruff, S.I. & Conway, T.L. [52]. A longitudinal assessment of the impact of	• health • fitness status • exercise	• perceived quality of life • health behaviours • accident prevention	• 519 navy personnel • over 2 years • 10% women

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
health/fitness status and health behavior on perceived quality of life.		• diet	• aged 17-52, average 29 • 89%white • 11% black • average 12 years education

Table 3. Children and youth

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Dwyer, J.J.M., Allison, K.R. & Makin, S. [59]. Internal structure of a measure of self-efficacy in physical activity among high school students.	• vigorous physical activity	• physical self-efficacy with respect to internal and external barriers	• 1041 high school students • aged 20 or less • male/female ~ even split
Frydenberg, E. & Lewis, R. [61]. Boys play sport and girls turn to others: age, gender and ethnicity as determinants of coping.	• physical recreation • sport	• coping behaviour and styles	• 673 secondary students -49% male -51% female • aged 12 - 17 • 74% Anglo-Australian
Hoffstetter, C.R., Hovell, M.F. & Sallis, J.F. [58]. Social learning correlates of exercise self-efficacy: early experiences with physical activity.	• exercise	• exercise self-efficacy	• 2053 adults • demographics over-represented include: -affluent -Caucasian -educated • not broken down by gender
Leonard, II, W.M. [60]. Physical activity and psychological well-being among high school seniors.	• physical activity	• psychological well-being	• 2,560 secondary school students -52% male -48% female • 84% whites • education of parents
Mundy, J. [55]. Developing anger and aggression control in youth in recreation	• recreation	• anger and aggression management	• youth
National Centre for Chronic Disease Prevention and Health Promotion (1997). [57] Guidelines for school and community programs.	• physical activity • exercise • fitness	• health benefits: -physical -psychosocial (self-esteem, self-concept, anxiety, stress)	• children and youth
Physical activity and sport in the lives of girls [4]	• physical activity • sport • exercise		• girls

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Ragheb, M.G. & McKinney, J. [29]. Campus recreation and perceived academic stress.	• leisure satisfaction • campus recreation (some sedentary) • exercise and fitness activities	• perceived academic life stress	• 343 students -females 58% -19% grad students -38% not employed -average age 21.3

Table 4. Older adults

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Conn, V.S. [67]. Older adults and exercise: path analysis of self-efficacy related constructs.	• exercise • lifelong leisure exercise	• self-efficacy • outcome expectancy • perceived barriers to exercise • perceived health	• 147 older adults -102 (69%) women -45 (31%) men • aged 65-100 • independent and ambulatory • most Caucasian • most low/moderate income
Dunn, N.J. & Wilhite, B. [69]. The effects of a leisure education program on leisure participation and psychosocial well-being of two older women who are home-centred.	• leisure	• psychosocial well-being	• 2 older women • aged 94 and 77 • home-centred
Dupuis, S.L. & Smale, B.J.A. [68]. An examination of relationship between psychological well-being and depression and leisure activity participation among older adults.	• leisure activity participation	• psychological well-being • depression	• 743 adults -427 women -316 men • aged 55 or older • marital status
Gill, D.L., et al. [62]. Physical activity and psychological well-being in older women.	• physical activity	• healthy functioning • quality of life • psychological well-being: -self-efficacy (activity) -general well-being -ratings of health and well-being	• 130 women • aged 65-95 • healthy • housing situation • ethnicity • work status • marital status • education • experience with falls
Jackson, L.T. [64]. Leisure activities and quality of life.	• leisure • physical activity	• quality of life -physical well-being -interpersonal relations -personal development -recreational activities -spiritual and transcendental activities • perceived pain	• older adults in nursing homes

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
		• positive affect	
McAuley, E. & Rudolph, D. [39]. Physical activity, aging and psychological well-being.	• physical activity	• psychological well-being	• older adults
Morgan et al. [66]. Customary physical activity , psychological well-being and successful ageing.	• customary physical activity • energy cost • functional capacity	• psychological well-being • mood • morale • mental health	• 1,042 adults -636 women -406 men • aged 65 and older
Ruuskanen, J.M. & Ruoppila, I. [65]. Physical activity and psychological well-being among people aged 65 to 84 years.	• physical exercise • walking • home gymnastics • daily activities	• psychological well-being • depression • meaningfulness of life • subjective health	• 1244 adults • 66% women • aged 65-84 • living at home

Table 5. Ethnicity

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Jackson, A.P. & Sears, S.J. [73]. Implications of an Africentric worldview in reducing stress for African American women.		• stress and worldview (ethnicity and culture) • psychological well-being	• African American women
Zimmer, Z. & Lin, H-S [72]. Leisure activity and well-being among the elderly in Taiwan: testing hypotheses in an Asian setting.	• leisure activities • participation • physical activity • creative activity • contemplative activity • social activities	• emotional well-being • role expectations • self-concept	• 4,049 • Taiwanese elders • aged 65+ • gender -57% men

Table 6. Disability

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Campbell, E. & Jones, G. [74]. Psychological well-being in wheelchair sport participants and non-participants.	• sport	• psychological well-being: -mood -trait anxiety -self-esteem -mastery -self-perceptions of health and well-being	• 93 wheel chair sport participants -72 men -21 women • 29 non-participants: -12 men -17 women • mean age ~26
Greenwood, C.M. et al. [75]. Self-efficacy and psychological well-being of wheelchair tennis participants and wheelchair non-tennis participants.	• sport	• psychological well-being • self-efficacy	

Paper or Report	Physical activity key words	Health and well-being key words	Population diversity key words
Hart, L.K., Freel, M.I. & Milde, F.K. [78]. Fatigue	• activity • exercise	• fatigue	
Hawkins, B.A. [77]. Health, fitness, and quality of life for older adults with developmental disabilities.	• leisure • physical activity • recreation	• well-being	• developmental disabilities • older adults
Nosek, M.A. [81]. Wellness among women with physical disabilities.		• wellness -self-regulation -friendship -love -sexuality	• 31 physically disabled women • mixed ethnicity • aged 22-69 • sexual orientation • education • education/work • marital status
Paulsen, P. et al. [76]. Comparison of wheelchair athletes and non-athletes on selected mood states.	• sport	• mood states	• general
Vercoulen, et al. [79]. Physical activity in chronic fatigue syndrome: assessment and its role in fatigue.	• physical activity	• chronic fatigue syndrome	• 150 patients -50 chronic fatigue -50 multiple sclerosis -50 healthy • age • sex • education
Wigers, S.H., Stiles, T.C., & Vogel, P.A. [80]. Effects of aerobic exercise versus stress management treatment in fibromyalgia.	• exercise	• fibromyalgia treatments: -aerobic exercise -stress management -treatment as usual	• 60 patients -55 women -5 men • age 23-73 • out of work 55%

J. References

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II. BODY IMAGE AND SELF-ESTEEM

Amanda Vogel, M.A.

A. Chapter Overview

What do we know?

Women frequently cite appearance enhancement and/or weight control as primary motives for participating in fitness programs. Some studies suggest that being active does little to improve women's body image concerns, while other research points to women's increased body image satisfaction through physical activity.

Women's self-esteem is linked to body image and exercise. Often women experience a sense of accomplishment associated with a commitment to exercise; in turn, these feelings enhance self-esteem. However, the process of becoming physically active can cause certain women to experience lowered self-esteem. Typically, this diminished self-esteem is connected to cultural expectations of an ideal female physique.

What do we need to research?

Many quantitative research measures are no longer appropriate for studying the changing female body image and the "ideal" figure. Researchers must begin to employ the newly developed scales which are designed to address contemporary dimensions of body image. Through research, it is important to address practical issues, for example:

- consider avenues for alleviating widespread body image concerns
- determine how self-esteem can be enhanced through physical activity
- address the impact of the exercise environment
- ensure sample diversity vis-a-vis age, ethnicity, sexual orientation and socioeconomic status

What should we do?

There are various strategies to promote positive body image through physical activity for girls and women.

- Ethics in advertising: promote the use of ethical standards by fitness advertisers (similar to the standards enforced for ethics in research) so that health promotion advocates and policy makers can help to guard against advertising schemes that promote an unrealistic physical ideal for women in connection to exercise.
- The role of the fitness professional: the development of educational packages and programs designed to alert fitness educators to the association between exercise, body dissatisfaction and self-esteem.
- The role of physical education: from the very beginning physical education needs to be a positive and supportive experience for girls. Schools and sports clubs need to implement activity, exercise and sport programs that focus on developing self-confidence, self-esteem and well-being by using strategies such as cooperative team activities.

B. Introduction

Historically, the concept of the self has been viewed as a broad and stable sense of identity [1]. However, contemporary social theorists suggest the self is subject to change according to life experience [1]. Although self-concept is often considered synonymous with self-esteem, the former is a cognitive (perceptual) component of the general self while the latter is considered an affective (evaluative)

component [2, 3]. Self-concept refers to “the total description (characteristics and abilities) an individual provides of herself” [3; p. 3]. According to Edwards [3], “self-esteem is the foundation of emotional well-being” [p. 5]. It refers to a person’s negative and positive evaluations of her or his self-worth [1-3]. An individual’s self-perceptions can be highly interrelated with his or her self-esteem. For example, equating the shape and size of one’s body with one’s individual self-worth exemplifies how an aspect of self-concept (perception of the body) can translate into feelings of self-esteem.

This chapter is concerned with exercise and its association with perceptions and evaluations of the self. Although self-concept encompasses a large configuration of self-descriptions, this discussion will focus on women’s physical self-perceptions (i.e., body image) and how these physical self-perceptions translate into physical self-esteem (feelings of self-worth associated with the body). This review builds on the more general discussion of self-esteem in the context of psychological health and general well-being that can be found in the first chapter of this collection.

1. Body image

Research on body image and exercise has been well-documented on both quantitative and qualitative fronts [4-7]. Although there exists a general understanding of body image as “the subjective image of one’s own body” [8; p.99], the study of body image often exceeds measurements of self-perception. Some studies are concerned with subjects’ attitudes towards various body parts and functions [6, 9]. Other researchers investigate the relationship between body image and exercise behaviour [10] and/or body image and social relations in physical activity settings [11]. Drawing on the multiplicity of dimensions governing body image definitions, Pruzinsky and Cash [12] outlined seven major themes associated with current research. Along with perceptions of the body, the authors defined body image to be a reactive and developmental phenomenon that can be associated with behaviour, attitudes, spatiality, self-worth, information processing and social relations.

Often researchers use terms other than body image to describe the same, or similar concepts. Such terms include body cathexis [6], Social Physique Anxiety [13, 14], public body consciousness [15], body concept [16, 17] and physical self-perception [2].

2. Physical self-esteem

In her essay on the sociocultural determinants of body image, Fallon [18] explained that “women are more likely than men to equate self-worth with what they think they look like and what they believe other people think they look like” [p. 81]. Research confirms appearance and self-esteem are interrelated in girls and women [4, 17, 19, 20]. Zion [17] was one of the first researchers to deal with the concept of one’s body in relation to the concept of one’s self. In a study with 200 college women, she found a significant linear relationship between self-description and body description; the ideal self and the ideal body; the discrepancy between self-description and the ideal self; and the discrepancy between body-description and the ideal body. Zion [17] concluded that “the security that one has in one’s body is related to the security with which one faces one’s self and the world” [p. 494]. Based on a number of studies of adolescents, body image and self-esteem, Freedman [20] concluded that, for females, “good looks are stereotypically associated with personal worth” [p. 34]. Further, girls who reported low personal adjustment also rated themselves low in attractiveness.

3. Rationale

The relationship between women’s body images, self-esteem and their participation in exercise is significant because the fitness industry typically promotes “working out” as an avenue to lose weight and attain an attractive appearance. Some researchers have suggested that exercise for the sake of appearance enhancement can trigger obsessive body image concerns [21, 22]. Such a situation can be especially detrimental to women’s well-being because an excessive concern with weight loss, body image and exercising can lead to dangerous weight control practices such as exercise addiction and/or exercise-induced eating disorders [23]. Further, a multitude of studies show a clear link between women’s body

image perceptions and their feelings of self-esteem [4, 19]. An examination of the relationship between exercise motives, body image, self-esteem and physical activity is a necessary contribution to women's health research.

C. Literature Review

1. Body image

As the general population becomes more active, the study of body image and its association with physical fitness has become an important area of research. Traditionally, the study of body image has emphasized women's, rather than men's, self-perceptions. The overall focus on women has developed because the majority of research shows that, despite being physically active, women are more dissatisfied than men with their bodies [4, 24, 25]. Many researchers have concluded that appearance enhancement and weight loss are women's primary motivations for exercising. For example, in the 1988 Campbell's Survey of Well-being of Canadians, female respondents revealed that they considered weight control the most important reason for engaging in physical fitness [26]. Based on their questionnaire results, Cash, Novy and Grant [27] concluded that:

> The management of weight and appearance (through exercise) is a stronger behavioral motivator among many college women than are reasons related to managing health/fitness, stress/mood, and social interaction [p. 542-543].

They also discovered that women who reported greater body image dissatisfaction were more likely to cite appearance enhancement as motivation for exercising [27]. Female participants in a study by Smith, Handley and Eldredge [28] also reported appearance-related reasons for exercising. Other studies, employing qualitative measures, found an association between weight loss and women's attendance at aerobics [5, 10, 22, 29, 30]. In their study on body image and female aerobics participants, Frederick and Shaw [10] discovered that:

> Even when the women were specific about not participating in aerobics for the singular purpose of weight loss, the main reason for participation was still associated with body image and the "need" to improve physical appearance [p. 68].

The study of exercise and body image is multi-dimensional. Researchers employ a variety of quantitative and qualitative measurement techniques to tap subjects' feelings and perceptions about their physical selves. Quantitative research on body image and exercise typically involves the administration of psychometric questionnaires. These research designs incorporate either within group testing (pre- and post- measures) and/or between group testing (men and women; exercisers and non-exercisers). The majority of qualitative research on physical activity and body image is conducted using interviews and observations.

Some studies show that exercise leads to greater body image satisfaction in women [2, 9, 31]. Other researchers speculate that society's emphasis on fitness as an important characteristic of health may encourage "an exaggerated and narcissistic investment in the body," thus exacerbating women's elusive pursuit of an "ideal" physical form [4; p. 42]. Results from other studies are inconclusive [32, 33] or suggest that women's experiences with body image are contradictory and more complex than measures of satisfaction/dissatisfaction can determine [5, 22, 30]. Although results vary, most studies reveal that women consider exercise and appearance to be highly interrelated.

Exercise & body image satisfaction

Certain research results have demonstrated that exercise improves body image satisfaction among active women. One such study investigated the relationship between amount of exercise and dimensions of body image [34]. Study results showed that increased fitness level was associated with "good body image" in both male and female exercisers [34; p. 1347]. Female exercisers in another study were

significantly more satisfied with their appearance than active male subjects [35]. Caruso and Gill (Study 1) [2] measured body image scores in male and female exercisers over a 10-week period and found that "physical self-perceptions and fitness are enhanced by participation in an exercise program" [p. 422]. Furnham et al. [16] discovered that active women in their study rated their bodies as significantly more attractive and expressed more satisfaction with their bodies than non-exercisers. The researchers concluded that the active women possessed more positive body concepts than the non-active women because exercise creates:

> A greater tolerance for shapes that deviate from the norm, and may have a valuable role to play in helping a broader range of female shapes to become culturally more accepted [16; pp. 349-50].

Other studies have also shown that subjects' involvement in exercise resulted in improved body satisfaction scores [9, 31, 36, 37].

Redican and Hadley [29] conducted a qualitative study in an urban health club. The researchers interviewed female aerobics participants and discovered that many of the women reported improved self-perceptions as a result of regular exercise:

> "I keep exercising because I feel healthier, fitter, and look slimmer."
>
> "I feel I wasn't doing enough exercise. I now feel fitter and healthier. I eat less and get into nice clothes" [p. 55].

It is imperative that researchers who examine body image and exercise consider the nature of women's improved body image satisfaction. For example, although many of the women in Redican and Hadley's [29] study were pleased with their health and appearance, they admitted that social and media expectations of female beauty influenced their level of satisfaction. Researchers who investigate body image among active women must address cultural pressures associated with the ideal, fit-looking female body.

Exercise & body image dissatisfaction

Other research results suggest that despite being active, women continue to express a multitude of body image concerns. For instance, Finkenberg, DiNucci, McCune and McCune [38] found little difference in body image scores between female controls and women who participated in vigorous activity. The researchers concluded that:

> Cultural pressures to meet an ideal standard (render) women participating in active exercise …dissatisfied with their bodies in terms of weight, even though they may have more positive attitudes towards physical condition [38; p. 791].

Similarly, Davis and Cowles [4] discovered that although male and female subjects displayed similar levels of fitness, the women were more dissatisfied with their bodies than their male counterparts. Adame, Radell, Johnson and Cole [39] conducted a study on female dancers and non-dancers. The dancers scored higher than the non-dancers on measures of fitness, however, there was no significant difference between the two groups on measures of appearance satisfaction. The researchers speculated that the dancers were especially critical of their bodies due to time spent exercising in front of mirrors. Although this is one possible explanation, these findings are difficult to interpret because several variables could be at play. First, other studies have shown that dancers are at high risk for developing an eating disorder because their profession demands an unusually thin physique [40]. Low body image satisfaction scores in the Adame et al. [39] study may be a product of this pressure.

Second, no difference in appearance scores between the dancers and non-dancers may be evidence that exercise does not improve women's body image perceptions. Other research points to this latter possibility. Caruso and Gill (Study 2) [2] found that physical self-perception and body image scores did not differ between a control group and groups of subjects involved in weight training and aerobic activity

over a 10-week period. Hallinan, Pierce, Evans, DeGrenier and Andres [25] studied female and male athletes and non-athletes. They asked subjects to identify their current body image and their ideal image from a nine-figure body-silhouette scale. Male athletes and non-athletes were equally satisfied with their current physiques. Conversely, both groups of female subjects showed significant differences between their current and desired shapes. Although this study supports the premise that exercise does not ameliorate body image concerns, the results should be considered with some caution due to the silhouette instrument used to measure ideal and current body shape. This issue will be discussed in further detail later in this chapter.

In a qualitative study, Markula [5] interviewed female aerobics participants about their body image experiences. She discovered that the women in her study expressed body dissatisfaction despite their physical activity levels:

> Many of my interviewees feel that they are continuously required to improve some part of their bodies. Occasionally – like Antoinette here – they reflect their unhappiness with a touch of irony: "…My roommates and I … are all in pretty good shape … but we think we are overweight or out of shape or we have too much fat" [5; p. 446].

It appears that many women interpret their fit body to be far from an ideal body (as defined by social and media standards). Further investigation of this discrepancy may help explain why many active, healthy women report persistent body image concerns.

Typically, body image researchers employ measurement techniques that focus on perceptions of one's body (i.e., Body Self-relations Questionnaire; [35]); or scores of satisfaction/dissatisfaction regarding specific body parts and functions (i.e., Body Cathexis Scale; [6, 41]). Recently, research in this area has focused on how body image affects exercise behaviour [10, 13, 14]. Much of this research employs the concept of Social Physique Anxiety to measure body image.

Social Physique Anxiety

Social Physique Anxiety (SPA) is defined as the degree of concern or anxiety associated with the effects of physique-related self-presentation. According to Hart, Leary and Rejeski [13], the term "physique" refers to "one's body form and structure, specifically body fat, muscle tone, and general body proportions" [p. 96]. Subjects who obtain high scores on SPA measures show a significant degree of self-consciousness about the public display of their bodies. Results from studies on SPA reveal that concerns about self-presentation influence exercise behaviour.

Hart, Leary and Rejeski [13] suggest that individuals who experience a high degree of anxiety associated with their physiques may be deterred from engaging in physical activity programs. Several studies have explored this proposition. Although research findings in this area reveal that Social Physique Anxiety does not entirely inhibit exercise behaviour, this phenomenon clearly influences exercise patterns. Spink [14] discovered that women who scored high on measures of SPA reported a preference for exercising in private settings. He speculated that these subjects avoided exercising in a public place because it allowed for others to evaluate their physiques. In a similar study, Frederick and Morrison [24] concluded that "having a high score on the anxiety scale may represent a less than … optimal state for exercise participants" [p. 971]. For example, they discovered that subjects with high SPA scores were more likely than subjects with low SPA scores to exercise for extrinsic reasons such as appearance enhancement. Although subjects with high SPA scores showed a strong adherence to exercise, the researchers questioned whether exercise with an extreme focus on appearance leads to heightened anxiety about appearance, or improved body image. Finally, this study revealed that female subjects were more likely than male subjects to show high scores on Social Physique Anxiety measures [24].

In their research on Social Physique Anxiety, Crawford and Eklund [11] focused on the aerobics class setting. These researchers speculated that exercise attire would have an effect on subjects' self-presentational concerns. They showed female subjects a video of exercisers in an aerobics class wearing either "tights and thong leotards that emphasized the physique/figure," or "contemporary style T-shirt and

shorts workout gear ... to de-emphasize the salience of the physique/figure" [11; p.435]. The researchers found increased SPA was associated with increased preference for the T-shirt and shorts presentation. In other words, the more a subject reported feeling uncomfortable displaying her body in public, the more she expressed a liking for imagining herself exercising with people dressed in loose clothing. This indicated that "self-presentational concerns regarding the physique influence perceptions of exercise settings" [11; p. 79].

These researchers replicated their study and discovered both consistencies and inconsistencies with previous research [11]. As before, there was a significant positive correlation between SPA scores and appearance-related motives for exercising. Conversely, the replicated study revealed that high SPA scores were not associated with a preference for exercise attire that de-emphasized the physique. However, Eklund and Crawford [42] maintained that self-presentation concerns contribute to physical activity behaviours and preferences. For instance, women who scored high on the SPA scale were less favourable than women who scored low on the SPA scale towards an aerobics setting where men were present.

In a study that combined quantitative and qualitative data collection techniques, Frederick and Shaw [10] predicted that body image concerns might deter women from participating in aerobics. Although they did not employ the concept of Social Physique Anxiety, similar to the studies cited above, they investigated the association between women's body image and exercise behaviour. Survey results indicated that body image did not constrain subjects' participation in aerobics. However, analysis of interview data suggested that factors associated with body image altered participants' experiences at aerobics. Women who felt self-conscious about their bodies reported feeling less enjoyment exercising when they were confronted with other participants who wore body revealing clothes and/or seemed competitive over appearance and body weight. One woman explained that the presence of "skinnier girls" in aerobics made her "feel fat and out of shape" [10; p. 63]. Clearly, body image concerns are related to women's exercise experiences.

Part of the difficulty in clarifying the relationship between body image and the experience of physical activity may be related to the investigative tools available to researchers. The majority of the quantitative research cited in this chapter addresses the extent to which active women are satisfied/dissatisfied with their current body shape. Much of the qualitative work on body image and exercise has focused on women's specific interpretations of a desirable body image (i.e., what do active women consider to be an attractive body?) [5, 29, 43, 44]. Interview data suggest that there is a strong relationship between women's participation in physical activity and their pursuit of a stereotypical, fit-looking body image [5, 29, 43]. This fit-looking image reflects a physique that is thin as well as slightly muscular or toned.

A fit body is thin

There exists a general misconception among female exercisers and non-exercisers that an ultra thin body is synonymous with a fit body. Shaw [7] organized focus group interviews with female high school students in order to investigate girls' perceptions of fitness and body image. She discovered that the students equated a fit female body with a slim build. One student reported that "(f)itness means getting slim" [p. 36]. Another girl explained, "We don't think being physically fit is as important as looking fit" [7; p. 36].

Redican and Hadley [29] interviewed 12 women at an urban health club. They discovered that the women exercised in order to lose weight and "keep up with the (media) image" of a stereotypical, fit-looking woman [p. 55]. The participants' interpretations of a fit body are evidenced by the following interview responses:

> "The benefits I've found in exercise are that I'm fitter, slimmer, and have a smaller appetite. I hate fat unfit people."
>
> "Through exercise I don't want to gain muscle but just lose inches" [29; p. 55].

Both Shaw [7] and Redican and Hadley [29] conducted their studies a decade ago. Since then, media constructions of a fit body image have changed. Although societal representations of active women are still thin, muscularity is now part of the fit body equation. Data collected in contemporary studies on body image and physical fitness reflect current social expectations of a fit female physique.

A fit body is toned

In a study conducted on aerobics and body image, Markula [5] discovered that many participants were concerned with losing weight and toning their muscles in aerobics. One woman illustrated this point:

> "I prefer aerobics to (ballet), because in ballet you are supposed to be skinny and have no muscles. I mean muscles are not valued, just flexibility. In aerobics muscles are valued, because it shows that you've been doing aerobics for a while" [5; p. 439].

An aerobics participant in another study on body image conceded that muscle definition was an important part of an overall fit appearance [44]:

> "When I think specifically of a fit body I think of someone who is thin. And …of course you want the kind of Linda Hamilton, Terminator 2 body. That's what it is. Who cares if I can run 10 miles if I don't have that look" [44; p. 70].

Although some exercising women welcomed defined musculature [5, 44, 45], other women disapproved of muscles that were too developed or "bulging" [5; p. 441]:

> "Girls don't really work out their arms because if you work your arms, you get big arms, you look like a guy. It seems to be okay if you have strong legs, but if you are athletic and you have big arms, it's like she looks like a guy" [5; p. 336].

Studies that explore women's interpretations of a fit body are useful in clarifying the link between physical activity, perceptions of the body and self-esteem. As shown, many qualitative studies have examined this relationship [5, 22, 29, 30]. However, there is a dearth of quantitative research that investigates changing body image ideals in a society that increasingly emphasizes health and fitness. Most quantitative researchers continue to assume that women are interested in weight loss alone to achieve their appearance goals. Two studies, employing body-silhouette scales, have addressed this problem [16, 46].

Silhouette scales

Body image attitudes are most often measured by verbal descriptions and inventories [6, 13]. However, evaluations of the body are measured with visual representations, or silhouette scales. Some researchers have suggested that existing silhouette scales such as the widely used Body Satisfaction Scale (BSS) have become outdated [46, 47]. The BSS consists of nine drawings of female and male figures ranging from thin to obese. Subjects are asked to indicate the drawing that most closely resembles their current body, and the drawing that represents their ideal shape [25, 42]. The female figures presented in the BSS scale were designed to differentiate between slender and large physiques; these images do not possess any amount of muscle definition. Clearly, using this scale is problematic for researchers who investigate body ideals among exercising women. Silhouette scales designed to determine subjects' current and ideal physiques must offer contemporary depictions of the active body.

Two groups of researchers [16, 46] recently turned their attention to silhouette scales that depict contemporary, athletic female builds. Furnham and his colleagues [16] used sketches of nine female bodies ranging from emaciated to hypertrophic. Their sample consisted of four groups of 15 British women: non-exercisers, bodybuilders, rowers and netballers (similar to basketball). Results revealed that the three groups of exercisers displayed more acceptance of the muscular body shapes (despite their "divergence from cultural ideals") than the non-exercisers [16; p. 335]. However, the researchers also pointed out that the groups of athletes perceived certain aspects of the body silhouettes very differently. For example, the netballers showed a stronger desire to conform to social standards of an ideal female

figure by rating the most muscular drawings with less favourability than the rowers and bodybuilders. Furnham et al. [16] speculated that the more an athlete relies on muscularity for her sport, the more she will perceive muscular images in a favourable light.

Lenart and her associates [46] developed the Athletic Image Scale using computer imaging to create various athletic body shapes. Unlike Furnham et al. [16], they discovered that both exercisers and non-exercisers reported a greater preference for images with muscle definition. Greater than sixty per cent of all subjects preferred images of athletic shapes not previously depicted in body silhouette scales:

> Analysis showed no relationship between current and ideal physique choice and exercise status. Most exercising and nonexercising women chose a mesomorphic ideal physique with upper-body muscularity unlikely to occur without substantial amounts of physical activity [46; p. 831].

These findings suggest that sociocultural body ideals are shifting to include toned/muscular silhouettes. Further, these cultural norms have a greater influence on women's body image preferences than "personal patterns of activity" [46; p. 845].

As the study of body image and exercise progresses, more research employing these up-to-date measuring techniques should come to the forefront. Lenart et al. [46] recommended that their study be replicated with a more heterogeneous sample (the majority of their subjects were white, college-aged women). For instance, different cultural groups often possess different body image preferences and beauty ideals [48]. Investigations which focus on women of colour and their ratings on the Athletic Silhouette Scale, or another scale designed to tap cultural differences in body image, would further contribute to this area of research. Lenart and her colleagues [46] also advised researchers to examine "why a particular figure is chosen as an ideal" [p. 845]. As shown in the Furnham et al. [16] study, a strong commitment to a particular sport or activity may influence one's preference for a certain physique.

In conclusion, studies show that active women generally remain dissatisfied with their appearances and/or experience self-consciousness about displaying their bodies during public exercise [4, 5, 14]. The prevalence of body image dissatisfaction among female exercisers (and non-exercisers) raises important questions about women's self-esteem.

2. Physical self-esteem

After reviewing a number of studies on body image, Ben-Tovim and Walker [19] asserted that the "link between body satisfaction and self-esteem has been repetitively confirmed" [p. 157]. However, Edwards [3] pointed out that this relationship "is complicated and the specific dynamics vary from person to person" [p. 15]. For instance, some women experience low self-esteem as a direct result of body image dissatisfaction. In other cases, overall feelings of worthlessness may translate into negative perceptions of the body [3].

As with body image, the association between self-esteem and exercise is multi-dimensional. Some women report enhanced self-esteem and confidence as a result of physical activity [22, 30, 49]. In some cases, these feelings of self-worth are related to physical accomplishment and a commitment to exercise. For example, an aerobics participant in a study by Warrick and Tinning [30] felt confident about the fact that she started participating in aerobics and "kept it up" [p. 20]. In other situations, women's improved self-esteem is due to weight loss and perceived appearance enhancement [10, 43]. Conversely, some women do not report heightened self-esteem as a result of physical activity [4]. In fact, the exercise experience itself can inhibit feelings of self-worth for certain women [22], possibly as a result of anxiety at being observed while exercising, or failure to achieve a desired body image.

Improved self-esteem

Some researchers believe that self-esteem is "the psychological variable with the most potential to reflect psychological benefits as a result of regular exercise" [2; p. 416]. One woman in a qualitative study explained how participation in physical activity heightened her self-esteem: "When I go home from

aerobics my sense of self-worth is so much greater and I feel a different person than I was years ago" [30]. Kenen [49] discovered that many women in her qualitative study on aerobics expressed "feeling better about themselves" as a result of exercise [p. 78]:

> For (some women), fitness seems to enhance an inner sense of well-being and integrity that makes them feel more comfortable about themselves and gives them more self-confidence. A few feel that this newly gained self-confidence with fitness flows into diverse areas of their lives as well [49; p. 78].

These studies suggest that women who are committed to an active lifestyle enjoy the benefits of improved self-esteem. Eickoff, Thorland and Ansorge [50] demonstrated that introducing an individual to a regular exercise regimen also enhances well-being. Female subjects who had been classified in the lower levels of cardiovascular fitness showed beneficial changes in psychological scores associated with the physical self following a 10-week aerobics program [50].

As shown, increased self-esteem among some active women is associated with the accomplishment of becoming physically fit and/or committing oneself to an exercise program. However, other evidence indicates that, for some exercisers, self-esteem is linked more specifically to dimensions of body image and appearance enhancement. Markula [43] found that some aerobics participants overtly connected self-esteem with appearance: "one's self feels good if one's body looks good" [p. 95]. One participant explained how weight loss boosted her self-esteem:

> "Every day I go to aerobics and it's painful, but then the other 12 hours a day I feel really confident in my jeans because they are looser ... you look better, you feel better ... you look skinnier, you feel more confident about your body, like you work and you deserve to look good in this dress" [43; p. 95].

A woman in another study expressed a similar experience [10]. Although she did not enjoy aerobics, this participant reported feeling "really good" about herself after exercising because she was working on her body shape [10; p. 70].

No improvement in self-esteem

Other research shows that participation in physical activity does not always result in improved self-esteem, despite weight loss and/or enhanced appearance. Davis and Cowles [4] surveyed active male and female subjects about body image and self-esteem. One dimension of this survey, Body Focus, indicated that, unlike their male counterparts, female subjects "placed greater importance on their appearance as an influence on their feelings of well-being" [4; p. 33]. In this study, Body Focus was defined as the importance an individual places on the way she or he feels about her or his body in connection with the way she or he feels about her- or himself in general. A 6-point Likert scale measured subjects' responses (1=very important to 6=not at all important). The mean score for women under 25 years old was 1.52 with a maximum range of 3.00; no subject in this group (n=75) rated perceptions of the body as unrelated to self-esteem. For women over 25 years of age (n=37), mean Body Focus scores were similarly low at 1.73 [4]. Considering that these same subjects reported significant body dissatisfaction, the unequivocal connection between their appearance and well-being is not encouraging.

Davis and Cowles [4] attributed their results to the fact that "(p)hysical health and physical beauty are so often coupled in media images that, implicitly, pursuit of the one would appear to guarantee the other" [p. 42]. Thus, society's emphasis on a thin, fit-looking ideal explains why "a large proportion of relatively slender and active women want to lose weight" [4; p. 41]. Warrick and Tinning's [30] findings support this line of thought:

> While some research suggests that a woman's self-esteem and body image can be enhanced by physical activity and that active women are more positive about themselves and their bodies … the sociocultural stereotype of (the) female physique and desire for slenderness can have a deep

> effect even on active women and may counteract (improved self-esteem and body image) [30; p. 22].

The pressure to appear physically attractive can create an uncomfortable situation for some female exercisers. One woman's experience exemplified the relationship between body image and feelings of self-worth in the exercise setting:

> "I always feel embarrassed about 'revealing all' in a leotard because of my size. My few experiences at aerobics have been helpful in a physical sense, but I leave the gym with my self-esteem at rock bottom. How can I cope with this emphasis on the 'body beautiful?'" [22; p. 8].

Clearly, body image and physical activity influence women's self-esteem in a variety of ways. There is a need for more research that focuses on self-esteem and its association with the physical self. Additionally, researchers must determine how women's body image experiences and self-esteem can be improved and supported during exercise.

The exercise environment

The exercise environment plays an important role in the shaping of self-perception and the enjoyment of exercise. As mentioned in the literature review, some women reported feeling uncomfortable exercising in an aerobics class where other women appeared competitive over weight loss and/or wore body-revealing attire [10, 42]. Some researchers have suggested that a focus on competition during exercise can hamper women's and girl's positive self-perceptions and self-esteem [3, 51, 52]. Marsh and Peart [52] conducted a study on how cooperative versus competitive physical activity programs affected body image and physical ability scores in girls. They discovered that a cooperative program enhanced perceptions of physical ability and appearance, while a competitive program lowered these variables. Edwards [3] agreed that "efforts to enhance self-esteem in adolescent females should focus on fun, skill development and cooperation (instead of winning)" [p. 20].

Other researchers have called for a commitment to changing the current focus on weight loss and beauty enhancement in exercise [7, 10, 51]. These researchers asserted that fitness instructors, educators and coaches can be influential in focusing attention away from body image dissatisfaction and/or weight loss in the exercise setting. For example, Frederick and Shaw [10] advised fitness instructors to refrain from discussions about exercising for the purpose of weight loss [10]. These recommendations are valuable for developing practical guidelines for the enhancement of body image and self-esteem among female exercisers.

3. Under-represented populations

Samples gathered for research on both body image and self-esteem in relation to exercise are often too heterogeneous in age-range, cultural background, race, sexual orientation and socioeconomic status. Most subjects in quantitative research come from a population of young, affluent, white, university students. Many participants in qualitative research on body image represent demographic norms of the typical aerobics participant: a "white, well-educated, 18- to 45-year-old female" [5; p. 430].

There has been a serious lack of attention paid to the relationship between physical activity, self-esteem and body image for children, especially girls. However, the research that has been conducted indicates that there is a strong positive relationship between physical activity and self-esteem.

> Girls who felt most confident about themselves and their abilities were more likely to participate in physical activity at higher levels than girls who felt less confident. Younger girls derived positive self-esteem from the approval of others and through a belief that girls are capable of playing sports well [53; p. 21].

As girls develop into adolescence, it appears that self-comparisons and approval from adults become more important for girls than for boys because boys seem to rely on self-referenced information more

often [53]. Although body image plays a role in self-esteem for boys, the pressure to attain an ideal physique bears more heavily on girls [53]. Unfortunately, the lack of research on sport participation and cessation rates for girls, methods of enhancing girls' self-perceptions of physical ability, the various types and settings of physical activity, and diversity within this population (ethnic, economic, ability) make it impossible to fully understand and support the relationship between physical activity, self-esteem and body image.

There are only a handful of studies that examine the topic of body image and exercise in a senior population [54-57]. Some research indicates that as active women become older, health plays a greater role in measures of heightened self-esteem than appearance [54]. However, other researchers have speculated that "a major motive for elderly women to engage in physical activity might be to maintain or achieve a certain body-shape ideal perceived by the subjects to be endorsed by society" [55; p. 454]. More research on seniors, body image and exercise is in order.

Few studies on body image, self-esteem and exercise address issues of race, economics, disability, sexual orientation or the experiences of large-sized women. Dattilo, Dattilo, Samdahl and Kleiber [58] examined the leisure orientations of low-income women who were predominantly African American and overweight. Although other studies have shown that women who are dissatisfied with their appearances are motivated to exercise [10, 24, 27], Dattilo et al. [58] identified body image dissatisfaction among their subjects as a major leisure constraint. Another study on obese women found no improvement in measures of body image and self-esteem following a 24-week low-impact aerobics program [59]. Researchers need to understand how exercise experiences and measures of body image differ across diverse samples.

D. Summary

In summary, women frequently cite appearance enhancement and/or weight control as primary motives for participating in fitness programs [10, 26, 29]. Although numerous studies suggest that being active does little to improve women's body image concerns, other research points to women's increased body image satisfaction through physical activity [2, 4]. Studies on Social Physique Anxiety indicate that one's exercise preferences and behaviour are related to one's degree of concern over body image [14, 42].

Women's self-esteem is also linked to body image and exercise. Often women experience a sense of accomplishment associated with a commitment to exercise; in turn, these feelings enhance self-esteem. Some active women experience self-esteem as a result of weight loss and appearance enhancement, while other exercising women do not report improved self-worth associated with body image. Finally, the process of becoming physically active can cause certain women to experience lowered self-esteem. Typically, this diminished self-esteem is connected to cultural expectations of an ideal female physique.

E. Gaps in the Literature

Based on the literature review, several gaps in the existing research have come to the forefront. There has been a serious lack of attention, primarily in quantitative research, paid to women's interpretations of a fit female body. Interview data has demonstrated that there is a strong relationship between the participation of women in physical activity and their pursuit of a stereotypical fit-looking body image, and that this image has changed over the past decade to one that is thin as well as slightly muscular or toned. Many quantitative measures are no longer appropriate for studying this changing female body image and "ideal" figure. Researchers must begin to employ the newly developed silhouette scales, which are designed to address contemporary dimensions of body image.

Most research on the relationship between physical activity, body image and self-esteem has failed to address practical issues. Researchers must consider avenues for alleviating widespread body image concerns. They must also determine how self-esteem can be enhanced through physical activity. In most cases, the impact of the exercise environment has not been adequately assessed. Overall, there is a severe lack of sample diversity vis-a-vis age, ethnicity, sexual orientation and socioeconomic status. Most research subjects for both quantitative and qualitative studies on body image and self-esteem are white,

young to middle-aged, well-educated women. Researchers need to consider how the experience of physical activity and measures of body image and self-esteem differ across diverse samples.

F. Implications

1. Research recommendations

Whether women's body image and self-esteem are enhanced as a result of physical activity is not entirely conclusive. However, several steps can be taken to improve research in this area, and thus clarify study results. For example, quantitative researchers need to pay greater attention to women's specific interpretations of a fit female body. By recognizing that contemporary cultural depictions of an ideal female form are slender as well as slightly muscular, researchers can more easily pinpoint the role exercise and physical activity play in perceptions of body image and therefore self-esteem. Silhouette scales that offer visual representations of female athletic body builds are a necessary step towards improving research in the area of exercise and body image.

There is also serious need for researchers to better understand the exercise environment and how it affects women's experiences with self-esteem, body image and physical activity. By utilizing an interdisciplinary research perspective and considering the physical, psychological and social context of exercise, in addition to other forms of physical activity in the daily lives of girls and women, researchers can clarify the relationship between activity, self-esteem and body image. Such a process will involve addressing practical guidelines and applications for improving women's body image and self-esteem in the context of physical activity.

Finally, understanding the relationship between physical activity, body image and self-esteem for girls and women is restricted by a lack of sample diversity. Only by considering differences in ethnicity, sexual orientation, size, ability, age and socioeconomic status can investigators understand the complex relationship that exists between physical activity, body image and self-esteem among girls and women.

Suggested research questions

1. Do female exercisers and non-exercisers share similar interpretations of a fit, attractive female body (based on the use of modernized silhouette scales and ongoing qualitative inquiries)?
2. How has culture's changing image of the ideal female form (to include a more muscular body) affected female exercisers? Do active women consider the "fit-look" to be an added pressure and/or an expansion of culturally accepted body types?
3. Do active women report heightened self-esteem more frequently as a result of physical accomplishment/commitment or as a result of gaining/maintaining a culturally defined aesthetic ideal? What accounts for this difference?
4. Does cultural/racial/sexual/economic experience influence women's perceptions of body image and physical self-esteem within the exercise setting?
5. Does the silhouette scale (and other verbal body image inventories) address the body image issues that are relevant to various racial and cultural groups?
6. How do older women/young girls perceive and evaluate their physical selves as a result of exercise?
7. What practical applications can be taken to enhance women's body image satisfaction and feelings of self-esteem in the context of physical activity?

2. Policy recommendations

Although the nature of the relationship between physical activity, body image and self-esteem for girls and women needs further clarification, this review underscores the fact that a strong relationship does exist and that it may be positively supported through the development of appropriate policies and programs. For example, media representations of the "ideal" female physique can be damaging to self-esteem. By promoting the use of ethical standards by fitness advertisers, similar to the standards enforced for ethics in research, health promotion advocates and policy makers could help to guard against advertising

schemes that promote an unrealistic physical ideal for women in connection to exercise. This strategy could be supported by the development of educational packages and marketing schemes for the media that challenge the assumption that fitness level can be assessed by appearance or body shape.

Fitness professionals also play an important role in any strategy to counteract prevailing stereotypical images of a feminine physique. In some cases, fitness educators are contributing to these norms. The development of educational packages and programs designed to alert fitness educators to the association between exercise, body dissatisfaction and self-esteem would be useful. Fitness professionals require continuing education about how to support positive body image and self-esteem. In order to ensure the health and well-being of active girls and women, fitness managers must hire fitness professionals and programmers who are committed to educating their members and clients about the diversity of fit body types. Fitness programs and facilities could also focus attention away from weight loss and calorie counting (for example, by discontinuing the use of fitness class descriptions that emphasize appearance enhancement).

Finally, physical education needs to be a positive and supportive experience for girls from the very beginning. Schools and sports clubs need to implement activity, exercise and sport programs that focus on developing self-confidence, self-esteem and well-being by using strategies such as cooperative team activities. Although each of these policy recommendations would be difficult to implement and may not adequately counteract the negative messages that girls and women receive about their bodies and physical abilities every day, it is imperative that we start somewhere. The health and well-being of girls and women are closely linked to their perception of their body, their ability to be active, and their resulting sense of self-esteem.

G. Search Strategies

This literature review is based on two major search strategies: library database searches and identifying relevant material in the reference lists of articles obtained in the database searches.

The library database searches were carried out on a number of databases to find relevant articles published in psychology, women's studies, exercise, sport, recreation, health and human perception journals. These specific databases include:

- Women's Resources International 1972-9/1997
- Psychlit 1974-1997
- Sportdiscus 1975-9/1997
- Heracles 1975-1995

Specific search terms (key words) included all combinations of the following categories:

- physical activity, exercise, fitness, recreation, sport
- body image, body concept, self-perception, self-concept, Social Physique Anxiety
- self-esteem, physical self-esteem, self-worth

Because most of the research on body image and self-esteem has focused on female subjects, including specific searches for girls/women was not always necessary.

H. Literature Summary Tables

The following tables organize the literature reviewed with respect to body image and self-esteem. Only those articles that specifically investigated conceptions of body image and self-esteem are included. Reports and analyses that deal with contextual factors such as social and cultural norms and values can be found in the references section only.

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Adame, Johnson & Cole [35]. Physical fitness, body image, and locus of control in college freshman men and women.	• quantitative • psychometric questionnaires	• 123 college men • 120 college women • mean age: 17.8 years	• enrollment in introductory personal health course	• women – more positive scores on appearance than men • men – more positive scores on physical fitness than women
Adame, Johnson, Cole, Matthiasson & Abbas [34]. Physical fitness in relation to amount of physical exercise, body image, and locus of control among college freshman men and women.	• quantitative • psychometric questionnaires	• 123 college men • 120 college women • mean age: 17.8 years	• walking • jogging • swimming • aerobics • soccer • tennis	• those who were more fit scored higher on internal locus of control and positive body image
Adame, Radell, Johnson & Cole [39]. Physical fitness, body image, and locus of control in college women dancers and nondancers.	• quantitative • psychometric questionnaires	• 39 college women dancers • 120 college women nondancers	• modern • ballet • jazz dance	• no significant difference between groups on ratings of appearance
Balogun [32]. Body image before and after assessment of physical performance.	• quantitative • fitness testing • Body Cathexis Scale	• 45 female students • mean age: 22.5 years	• enrollment in health related course	• improvement in body image scores when given objective information on their fitness levels
Ben-Tovim & Walker [19]. Body attitudes review.	• review of various body image questionnaires and measures	N/A	N/A	• studies show that satisfaction with the body is closely linked to self-esteem
Caruso & Gill [2]. Strengthening physical self-perceptions through exercise.	• quantitative • fitness testing • psychological scales	Study 1 • 34 female students enrolled in physical ed. • mean age: 20.89 years Study 2 • 27 male students • 28 female students	Study 1 • weight training (n=13) • aerobics (n=15) • sports skills class (n=6) Study 2 • weight training • sports skills class	Study 1 • physical self-perceptions related to self-esteem and overall self-worth • self-perceptions enhanced by exercise Study 2 • no changes in physical self-perception for either group
Cash, Novy & Grant [27]. Why do women exercise? Factor analysis and further validation of the Reasons for Exercise Inventory.	• quantitative • Reasons For Exercise Inventory	• 137 college women • 80% white, 10% black, 10% “other racial group”	• various	• Appearance/Weight Management correlated with exercise frequency and motivation (esp. for women who scored high on appearance dissatisfaction)

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Crawford & Eklund [11]. Social physique anxiety, reasons for exercise, and attitudes toward exercise settings.	• quantitative • Social Physique Anxiety Scale (SPA) • Reasons For Exercise Inventory	• 104 female university students • exercised on average 3 days/wk	• aerobics	• subjects with high SPA scores rated the aerobics setting where participants wore baggy clothes as more favourable than the setting with body revealing clothes
Daley & Parfitt [33]. Physical self-perceptions, aerobic capacity and physical activity in male and female members of a corporate health and fitness club.	• quantitative • questionnaires • fitness testing	• 40 men & 33 women • members of British health club	• various	• inconclusive findings on a correlation between physical self-perception and exercise
Dattilo, Dattilo, Samdahl, & Kleiber [58]. Leisure orientations and self-esteem in women with low incomes who are overweight.	• quantitative	• 222 low income women • predominantly African American • predominantly overweight	• outings • family interaction • fitness activities	• reported leisure constraints included family responsibilities, finances, body image • positive correlation between being active and self-esteem
Davis & Cowles [4]. Body image and exercise: A study of relationships and comparisons between physically active men and women.	• quantitative • questionnaires	• regular exercisers • 112 women (mean age 23.5) • 88 men (mean age 28.45)	• members of a university health club • members of Toronto city fitness clubs	• women more dissatisfied with bodies • greater importance on appearance as part of well-being • more likely than men to exercise for weight loss
Davis [21]. Body image and weight preoccupation: A comparison between exercising and non-exercising women.	• quantitative • questionnaires • psychological scales	• 86 regular female exercisers (average age 22) • 99 non-exercising women	• exercisers from various fitness and track clubs	• dedication to exercise may foster heightened narcissism and body image distortion
Edwards [3]. Self-esteem, sport and physical activity.	• research overview	N/A	• various	• a discussion of current research on girls/women, self-esteem, body image and physical activity
Eickoff, Thorland & Ansorge [50]. Selected physio-logical and psycho-logical effects of aerobic dancing among young adult women.	• quantitative • psychometric measures • fitness testing	• 39 women (19 in control group) • aged: 19-36	• aerobics	• difference in psychological profiles from pre- to post- for “low fit” women only

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Eklund & Crawford [42]. Active women, Social Physique Anxiety, and exercise.	• quantitative • Social Physique Anxiety Scale	• 94 college-aged women	• aerobics	• replication of Crawford & Eklund, [11] • all subjects regardless of SPA scores preferred the aerobics setting with baggy clothes • results do not support previous study
Finkenberg, DiNucci, McCune & McCune (1993). Body esteem and enrollment in classes with different levels of physical activity.	• quantitative • The Body Esteem Scale	• 225 women (116 in active group; 99 less active) • 98 men (38 active group; 60 less active)	• aerobics • jogging	• in pre-testing, mean overall body esteem scores higher for “more active” women • no differences in post-testing • no differences between men
Frederick & Morrison [24]. Social Physique Anxiety: Personality constructs, motivations, exercise attitudes, and behaviors.	• quantitative • questionnaires • Social Physique Anxiety Scale	• members of a college fitness centre - 127 men - 199 women - mean age: 20.6	• fitness centre activities	• women had higher Social Physique Anxiety Scores than men • higher SPA scores related to more extrinsic reasons for exercising • higher public body awareness
Frederick & Shaw [10]. Body image as a leisure constraint: Examining the experience of aerobic exercise classes for young women.	• quantitative, questionnaire • qualitative, interviews	• 190 female students (survey) • 35 (of 190) interviewed	• aerobics	• body image concerns acted as a motivator for exercise • body image concerns (tight clothing) constrained enjoyment of participation in aerobics
Furnham, Titman & Sleeman [16]. Perception of female body shapes as a function of exercise.	• quantitative • silhouette scale for athletic female body builds	• 4 groups each with 15 female subjects	• bodybuilders • rowers • netball (British version of basketball) • sedentary	• exercisers had more positive perceptions of their bodies than controls • exercisers showed higher acceptance of muscular female body shapes
Goldberg, Bailey, Lenart & Koff, [47]. A new visual image rating scale for females: Correlations with measures of relative fatness, weight dissatisfaction, and body-esteem.	• quantitative • Visual Image Rating Scale	• 77 female undergraduate students • 86% white	• unknown	• test-retest reliability of scale • figure type rather than figure size may be an important factor when choosing a physique preference
Hallinan, Pierce, Evans, DeGrenier, & Andres [25]. Perceptions of current and ideal body shape of athletes and nonathletes.	• quantitative • Nine-point Silhouette Scale	• 117 female, athletes and non-athletes • 94 male, athletes and non-athletes • 17-30 years old	• various sports	• no difference in current and ideal body for either groups of men. Women athletes and non-athletes showed significant discrepancy between ideal and current body shape

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Hallinan & Schuler [55]. Body-shape perceptions of elderly women exercisers and nonexercisers.	• quantitative • silhouette scale	• Elderly women (66-88 years) • 49 exercisers • 29 non-exercisers	• exercisers were members of a university adult fitness program	• exercisers showed a greater discrepancy between current and ideal body shape than non-exercisers
Hart, Leary, Rejeski [13]. The measurement of Social Physique Anxiety.	• quantitative • Social Physique Anxiety Scale • physique evaluation	• 93 women • 94 men	N/A (authors recommend future use of SPA scale in fitness settings)	• women who scored higher on SPA tended to be heavier and higher % body fat
Kenen [49]. Double messages, double images: Physical fitness, self-concepts, and women's exercise classes.	• qualitative • interviews • observations	• women, details unspecified	• aerobics	• body image and weight loss interrelated with the focus of some aerobics classes
Koff & Bauman [36]. Effects of wellness, fitness, and sport skills programs on body image and lifestyle behaviors.	• quantitative • psychological scales • health-related surveys	• 140 female college students: - 33 wellness class - 60 fitness class - 47 sport-skills class	• wellness class (nutrition, fitness, stress management) • strength training • aerobics • running • tennis • racquetball	• body image, body relations and lifestyle scores were most improved from pre- to post-test in wellness group
Lenart, Goldberg, Bailey, Dallal & Koff [46]. Current and ideal physique choices in exercising college women from a pilot Athletic Image Scale.	• quantitative • Eating Disorder Inventory (EDI) • silhouette scale: Athletic Image Scale • (pilot study)	• university women • 65 female exercisers (athletes) • 45 non-exercisers	• collegiate sports	• exercising and non-exercising women chose ideal body shape as mesomorphic with some upper body muscularity • 60% of women preferred an athletic build not offered on traditional silhouette scales
Markula [43]. Looking good, feeling good: Strengthening mind and body in aerobics. Markula [5]. Firm but shapely, fit but sexy, strong but thin: The postmodern aerobicizing female bodies.	• qualitative • ethnographic fieldwork, interviews and media analysis	• 35 subjects (33 women, 2 men) • mostly white, educated • 18-45 years old	• aerobics	• women construct contradictory meanings about body image and aerobics • some feel pressure to conform to body ideal, others resist
McInman & Berger [37]. Self-concept and mood changes associated with aerobic dance.	• quantitative • questionnaires	• female aerobics participants (n=75) • female university students (n=42)	• aerobics	• aerobics participants showed significant but weak changes in some dimensions of self-concept (including appearance)

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Netz, Tenebaum, & Sagiv [56]. Pattern of psychological fitness as related to pattern of physical fitness among older adults.	• quantitative • fitness testing and psychological measures	• 11 men • 13 women • aged 50-64 • Kibbutz members	• stretching, calisthenics, jogging, walking	• women should lower well-being than men. • caution in generalizing due to lack of control group
Physical activity and sport in the lives of girls [53]	• literature review	• girls	• physical activity • sport • exercise	• general
Redican & Hadley [29]. A field studies project in a city health and leisure club.	• qualitative • interviews, participant observation	• 12 women • employed out of home • ages: 24-32	• aerobics	• body image and appearance was the most cited reason for attending the club/aerobics
Riddick & Freitag [57]. The impact of an aerobic fitness program on the body image of older women.	• quantitative • questionnaires	• 6 women, experimental • 8 women control • aged 50+	• low-impact aerobics	• fitness improved body image in subjects
Salusso-Deonier & Schwarzkopf [9]. Sex differences in body-cathexis associated with exercise involvement.	• quantitative • Body Cathexis Scale	• university students • 52 exercising women & 41 controls • 23 exercising men & 9 controls	• students in a university fitness class	• regular exercise improved body cathexis scores for both men and women in this study
Secord & Jourard [6]. The appraisal of body cathexis: Body cathexis and the self.	• quantitative • Body Cathexis-Self Concept Scale	• 70 men • 56 women • college aged	N/A	• subjects valued their bodies and their selves in a similar way
Seggar, Cammon & Cannon [31]. Relations between physical activity, body-cathexis, and psychological well-being in college women.	• quantitative • Body Cathexis Scale	• 323 university women (173 were athletes, the rest controls)	• various college sports	• physical activity related to improved body cathexis scores and reduced current/ideal weight discrepancies • no differences in psychological well-being between groups
Shaw [7]. Fitness and wellness for young women: The image paradox.	• qualitative • focus groups • quantitative • surveys	• 627 high school students (gender % unspecified)	• responses to fitness promotional posters	• subjects strongly associated the concept of “fitness” with a slim body type
SIRLS Sport & Leisure Database [60]. Sport & Body image.	• annotated bibliography of body image and exercise	N/A	• various sports and exercise	• current to 1991

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Skrinar, Bullen, Cheek, McArthur, & Vaughan [15]. Effects of endurance training on body consciousness in women.	• quantitative • Body Consciousness Questionnaire	• 13 women • aged 20-30 years	• intensive, progressive running program • volleyball, softball	• public body consciousness unchanged after exercise program but internal body consciousness and body competence increased.
Smith, Handley & Eldredge [28]. Sex differences in exercise motivation and body-image among college students.	• quantitative • Reasons for Exercise Inventory	• 100 college-aged women • 78 college-aged men • exercised at least 90 min/week	• various	• men and women similarly dissatisfied with specific body attributes • women exercised for appearance more than men
Spink [14]. Relation of anxiety about social physique to location of participation in physical activity.	• quantitative • Social Physique Anxiety Scale	• 37 female nursing students • ages: 17-19 years	• activities that took place in a private vs. public setting: • aerobics • team sports • running • walking • cycling	• subjects with high scores on the Social Physique Anxiety Scale reported a tendency for exercising in private rather than public
Thompson & Hirschman [61]. Understanding the socialized body: a poststructuralist analysis of consumers' self-conceptions, body images, and self-care practices.	• qualitative • interviews	• 16 females • 14 males • aged: 6-54 • one subject of Asian descent, rest white	• various health-related behaviours discussed	• body image strongly related to current health-related, consumer behaviours • discussion of how men and women view their bodies in a cultural context
Tucker [41]. Internal structure, factor satisfaction, and reliability of the Body Cathexis Scale.	• quantitative • Body Cathexis Scale	• 83 male students	N/A	• results show Body Cathexis Scale to be reliable
Warrick & Tinning [22]. Women's bodies, self-perception and physical activity: A naturalistic study of women's participation in aerobics classes - Part 1. Warrick & Tinning [30]. Part 2.	• qualitative • interviews, participant observations	• 50 women • aged: early 20s to mid-50s.	• aerobics	• multiple meanings emerged regarding exercise and body image issues
Vogel [44]. "Body image by association": Women's interpretations of aerobics and the role of the fitness instructor.	• qualitative	• 10 female aerobics participants • 4 female fitness instructors • 13 white, one of Asian descent	• aerobics	• multiple interpretations of body image and the role of the instructor • discussion of the fit body aesthetic

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Zion [17]. Body concept as self-concept.	• quantitative • questionnaire	• 200 female students	N/A	• significant linear relationships between ideal self and ideal body, self description and body description etc.

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III. EATING DISORDERS

Amanda Vogel, M.A.

A. Chapter Overview

What do we know?

There is an interdependent relationship between eating disorders and physical activity for girls and women. Eating disorders are common among female athletes who participate in aesthetically oriented sports, such as gymnastics and figure skating, and individual sports such as running.

Some researchers suspect that long training hours, combined with a focus on physical aesthetics and performance, contribute to disordered eating among female athletes. Other researchers believe that certain girls and women, who are predisposed to developing an eating disorder, tend to participate in sports that trigger this phenomenon.

What do we need to research?

Disordered eating among female athletes and recreational exercise merits ongoing research. It is important to research the relationship between eating disorders and exercise among under-represented groups, such as females with disabilities, visible minorities, lesbians, children, older adults, and low socioeconomic status girls and women. It is also important to consider eating disorders beyond anorexia nervosa and bulimia nervosa, such as overeating and compulsive exercise.

It is also important to include more qualitative research studies to elicit individual perceptions, as well as social and cultural norms and values. These methods must represent the voices of the female study participants so that their contribution to the research is recognized and valued.

What should we do?

In order to help address the rising incidence of eating disorders, it is necessary to target the different areas and stakeholders involved. For example:

- Fitness advertising and media messages should be encouraged to adopt ethical standards.
- Health and fitness leaders, in the community and in the education system, need to understand the link between exercise and eating disorders, and the implications of the social and cultural context with respect to themselves and their clients.
- Fitness professionals and facilities must resist prescribing a socially defined “ideal” weight as a necessary component of being fit and healthy.
- Public policy should communicate the dangers of overexercise and the pursuit of a thin ideal.
- Policy makers must consider the interrelationship between active women’s unhealthy relationship with food, their diminished power within a male-dominated society (and sports world), and cultural standards of female beauty which emphasize an ultra-thin physique.

B. Introduction

The incidence of eating disorders, a phenomenon that affects primarily girls and women, has progressively increased in Western societies over the last half-century. Although eating disorders are most common in teenagers and young women, an increasing number of cases is being reported across a range of age groups. The two most prevalent and widely examined eating disorders are anorexia nervosa and bulimia. Anorexia nervosa is characterized by self-starvation, and bulimia typically involves binge eating large quantities of food followed by bouts of purging. Most commonly, bulimics purge by means of vomiting, the use of laxatives and/or excessive physical activity. Some researchers believe that

disordered eating among women is largely a function of their oppressed position in a male-dominated society, and exacerbated by unrealistic standards of female beauty. While others agree that unattainable beauty ideals play a role in the onset and maintenance of disordered eating, they also maintain that psychological disturbances are at the root of this phenomenon. In any case, the study of eating disorders is an important component of women's health research. Many short- and long-term health consequences have been associated with chronic dieting and disordered eating. Chronic low caloric intake can lead to low energy and poor nutrition, as well as psychological stress [1]. In extreme cases of calorie restriction and/or binge/purging, individuals may experience low blood pressure, hair loss, a deterioration of dental enamel (from repeated vomiting), hampered cognitive functions, constipation, increased risk of heart attacks and stroke, and in some incidences death.

C. Literature Review

1. The anorexia analogue hypothesis

The association between eating disorders and physical activity came to the forefront of academic research in the earlier 1980s when Yates, Leehey and Shisslak [2] published a study suggesting that running was an analogue for anorexia. According to these researchers, similarities in personality and background can be drawn between women who suffer from clinically diagnosed anorexia nervosa – characterized by self-starvation – and male runners who exhibit compulsive and excessive exercise tendencies. This hypothesis was based on the premise that both anorexics and "obligatory runners" use food and exercise respectively to cope with intrapsychic disturbances, or as a result of shared personality characteristics [3]. Subsequent to the work of Yates et al. [2], a series of studies has emerged on the link between anorexia and athletes. Generally, these studies fall into two categories: the anorexia analogue hypothesis and the study of male runners [2-6] and the anorexia analogue and the study of female runners [7-10]. Some researchers have also examined the association between eating disorders and "obligatory" athletes from sports other than running [11, 12].

Many researchers have criticized the research methodology and analysis employed by Yates et al. [2] in their examination of the anorexia analogue hypothesis among male runners and female patients with anorexia [3, 5, 8]. For example, Owens and Slade [8] noted that although Yates et al. sampled 60 male runners, they only provided detailed information about three of the men. The authors also pointed out that comparing female runners to anorexic patients would be more appropriate since the latter group is typically comprised of women. Although Coen and Ogles [3] stressed that the anorexia analogue hypothesis is "specific to men" [p. 341], Nudelman et al. [5] recognized that their study was limited by the absence of female runners. It seems most pragmatic to compare two groups – female obligatory runners and female anorexics – who perhaps share similar personalities and backgrounds, as well as common experiences in a culture that strongly values thinness in women. Many researchers have taken this latter approach when recruiting samples for their studies [7-10].

In general, studies that investigate the personality characteristics and eating habits of female runners do not support the anorexia analogue hypothesis. Owens and Slade [8] reported that their study was "unable to find evidence of runners who showed significant parallels with anorexia"[p. 774]. Weight and Noakes [10] determined that:

> abnormal eating attitudes and the incidence of anorexia nervosa is no more common among competitive female runners than it is among the general population [p. 216].

The authors concluded that these findings "tend to refute the Yates hypothesis" [10; p. 216]. However, Yates et al. [2] did not specifically hypothesize that runners were at risk for developing an eating disorder, simply that they shared characteristics with individuals who have eating disorders.

Nonetheless, it has been well-documented that exercise and disordered eating are interdependent in many individuals with anorexia and/or bulimia; one study reported that 66% of 161 bulimic patients exercised at least 30 minutes per day [13]. In order to gain a better understanding of the link between physical activity and eating disorders, it may be most useful to move away from the parallels between

runners and women with anorexia. Instead, research should focus on the links between physical activity and disordered eating among female athletes. Along these lines, Gleaves et al. [7] conducted a study on body image and eating disturbance in women who experienced weight loss as a result of running. Although they suspected that the combination of exercise and weight loss would result in distorted body image and, subsequently, disordered eating, data did not confirm this hypothesis. The researchers found that there was no significant difference between the group of runners who had lost weight and the control group.

Other researchers have underscored the importance of the type of physical activity in the development and maintenance of body image dissatisfaction and disordered eating. There is a substantial body of literature that examines the correlation between specific sports and the incidence of eating disorders among the athletes who participate in these sports. For example, a study by Pasman and Thompson [11] examined body image perceptions in female and male runners. Unlike most other studies on obligatory athletes, Pasman and Thompson included weight lifters as an additional exercise sample. They determined that the type of physical activity performed may be related to body image perception and satisfaction with one's appearance. For instance, both male and female weight lifters estimated their body size more accurately than male and female runners. Although female runners were more dissatisfied with their bodies than male runners, there was no significant difference between male and female weight lifters.

2. Disordered eating among female athletes

In the same year that Yates and colleagues published their article on anorexia nervosa and the obligatory runner [2], Epling, Pierce and Stefan [14] conducted a study on food restriction and exercise in rats and developed a theory of activity-based anorexia. In the early stages of food restriction, physical activity increases (a biological response to stimulate the hunt for available food sources). As physical activity becomes more excessive, the appetite is suppressed and caloric intake decreases [14-17]. Epling et al. [14] hypothesized that the combination of exercise and food restriction can precipitate anorexia nervosa. Although laboratory outcomes in rats cannot be satisfactorily extrapolated to humans, the activity-based anorexia theory proposes that women who are concurrently dieting and exercising may be at risk for developing an eating disorder. Researchers have considered the relevance of such a theory in their investigations of female athletes, many of whom diet in order to achieve a body that is considered optimal for success in their respective sports [18-20].

In general, research concerned with disordered eating among active women is inconclusive. Some studies do not show evidence that female athletes are at risk for developing an eating disorder [21-23], while others reveal an association between certain sports and dysfunctional eating patterns [24, 25]. Crago et al. [21] studied collegiate athletes from a number of sports such as basketball, gymnastics, swimming and track. They determined that:

> there was no evidence to support the hypothesis that there has been an increase in anorexia nervosa-like symptoms among entering female intramural athletes [p. 84].

The authors pointed out that samples were relatively small in the sports most typically associated with anorexic-like symptomology (gymnastics and running). According to Crago et al. [21], the lack of data suggesting any incidence of anorexia may be due to the fact that:

> anorexics are not drawn to organized competitive sports because the stereotyped athlete does not fit the ideal of femininity to which the anorexic strives [p. 86].

Warren, Stanton and Blessing [23] also discovered that eating behaviour among female college athletes was in the normal range. They noted that participation in a sport that requires a low body weight does not suggest any risk for an eating disorder. However, gymnasts in this study showed the greatest body image dissatisfaction and drive for thinness. Warren et al. [23] attributed this finding to the aesthetic focus placed on the gymnast's body. Similarly, Brooks-Gunn, Burrow and Warren [26] expected that skaters and dancers would have more negative attitudes about eating than swimmers. As hypothesized, the skaters

and dancers, athletes from sports where aesthetics are paramount, reported more restrained eating and bingeing/purging than the swimmers. In another study, investigators concluded that:

> professional dancers are at a much higher risk for reporting eating disorders than are nonathletic women or even adolescent dance students [24; p. 474].

However, this was true for white dancers only; black dancers did not report any signs of anorexia or bulimia, suggesting that race and/or ethnicity may be related to disordered eating in athletes [24].

Some researchers have questioned whether participation in sports increases the likelihood of women developing an eating disorder, or whether certain individuals who are predisposed to an eating disorder are inclined to be particularly active [19, 20, 27, 28]. Some researchers have asserted that all adolescent girls and some adult female athletes are in jeopardy of developing an eating disorder, particularly if they compete at an elite level of competition [29]. In a study on college women from a variety of sports requiring both a thin and normal body build, Davis and Cowles [27] concluded that:

> strenuous exercise may increase the likelihood of developing an eating pathology among female athletes whose sport demands a thin body build [p. 535].

However, the authors called for further investigation to determine if individuals who are emotionally predisposed to an eating disorder gravitate to these types of activities. Walberg and Johnston [28] found that 17% of female weight lifters and 42% of female competitive bodybuilders in their study reported past incidences of anorexia. They speculated that:

> women with the tendency to develop anorexia nervosa select themselves into a sport where extreme leanness, high activity levels, and unusual diet manipulation are common [28; p. 35].

Other researchers have also argued that sports such as dancing, which rely on a very thin body aesthetic, support disturbed eating patterns and body image dissatisfaction [24, 30]. In other words, excessive dieting, long training hours and standards of thinness required for certain sports may lead to anorexia but may "not necessarily imply the same degree of associated psychological distress" as with nonathletic anorexic women [30; p. 301]. Davis et al. [19] further argued that for some women with eating disorders, participation in sport is "not merely the benign adjunct to pathological caloric restriction" but "an integral part of the pathogenesis … of the disorder" [p. 957]. In a study that combined quantitative and qualitative methodologies, these researchers found that 60% of female patients admitted to an eating disorders program (n=45) were regularly involved in competitive sports or dance before the onset of their eating disorder. Davis et al. [19] concluded that findings from their study support an activity-based anorexia hypothesis.

3. Disordered eating in a recreational exercise setting

Much of the research conducted on eating disorders and physical activity has focused on elite athletes [31-33]. Although eating disturbance among recreational exercisers has received much less attention, investigations in this area lend further insight into the link between eating disorders and exercise. For example, Richert and Hummers [34] examined the association between patterns of recreational activity and eating disorders among male and female university students. Subjects completed self-reports on their preferred forms of physical activity (i.e., swimming, hiking, weight lifting, aerobics, jogging), as well as the EAT scale, a commonly employed measure of eating patterns and attitudes associated with eating disorders. Subjects who scored in the "at risk" range on the EAT scale were primarily female (26 women and 3 men). Data revealed that "the only specific activity to show a significant correlation to possible risk for eating disorders … was jogging" [34; p. 761].

Davis [18] and Davis et al. [35] conducted research on avid female exercisers who engaged in activities such as swimming, exercise classes, jogging, weight lifting, figure skating and bicycling. In one of the studies, data indicated that 77% of relatively thin (according to Body Mass Index measures) active women expressed a desire to lose weight and most of them reported being on a diet [35]. The authors speculated

that a narcissistic focus on one's appearance as a result of exercise can lead to a "weight control-exercise cycle" and perhaps an eating disorder:

> It is suggested that the pursuit of physical fitness, and the implicit endorsement by those who promote exercise propaganda, that "very thin" is "very healthy", has created, in a group of normal weight (even slender) women who are psychologically susceptible, an exaggerated concern with weight control and super-critical view of their appearance [35; p. 572].

As with the issue of competitive sports, research on women's involvement in recreational activity raises important questions about whether regular exercise fosters a heightened degree of eating and body image concerns, or whether women who are predisposed to disordered eating and body dissatisfaction are generally inclined to participate in recreational exercise [18]. It is also possible that a combination of these two factors is at work [18].

There is a lack of studies which address the risk of eating disorders among role models of recreational exercise. Olson, Williford, Richards, Brown and Pugh [36] examined disordered eating among female group exercise instructors. Results revealed that 40% of the instructors (n=30) reported a previous experience with eating disorders. In addition:

> a number of the aerobic dance instructors possessed scores (on the Eating Disorder Inventory) suggesting behaviors and attitudes consistent with female athletes whose sports emphasize leanness and comparable to those who have eating disorders [p. 1051].

Conversely, in their examination of risk factors associated with this population, Martin and Hausenblas [37] found that "aerobics instructors generally do not display the behavioral and attitudinal correlates for eating disorders" [p. 186]. Group exercise is a popular recreational activity among women [38]. Yet, there is a dearth of research that addresses the possible links between eating problems and women who frequent (or instruct) fitness classes. Many researchers have suggested that a group exercise format, more than most other forms of physical activity, emphasizes appearance, weight loss and the attainment of a thin ideal [38, 39]. Therefore, it seems appropriate to consider fitness classes when attempting to explain the incidence and prevalence of eating disorders among active women.

4. Research design and methodology

Psycho-social research

To date, the majority of research studies concerned with exercise and eating disorders has employed quantitative methodologies. Most studies involve the use of measures and inventories that are designed to detect abnormal relationships with food and eating, interpersonal and intrapsychic dysfunction, and body image perceptions and satisfaction levels. However, a qualitative research design may be the most useful method for gathering information on study participants' own interpretations and points of view. Unfortunately, even in eating disorder studies that are based on qualitative measures such as interviews, the inclusion of subjects' words as data are largely absent [35, 40].

For instance, although Davis et al. [35] combined quantitative and qualitative methodologies in their study of eating disorder patients, little attention was paid to the latter data in their report of study results. The authors described how data from semi-structured interviews were analyzed and categorized into emergent themes, yet they failed to make use of significant portions of these interviews in their article. A similar approach was taken by researchers White and Montell [40] in their study of 60 women with eating problems. During their investigation (which involved informal interviews), they noticed that many women who had been clinically diagnosed as overeaters also appeared to actively resist engaging in exercise. Their study is unique in its focus on the links between overeating and resistance to, rather than dependence on, exercise. However, they failed to adequately illustrate their qualitative findings.

In contrast, Chapman [41] conducted a case study of eight women on a rowing team. She held individual, open-ended interviews with each woman about her experiences dealing with weight management. Unlike

the studies mentioned above, Chapman included a variety of interview segments in her body of work, allowing the reader to understand how each woman interpreted her own experiences with weight loss and eating. Currently, there is a paucity of research that employs qualitative methodologies and, at the same time, adequately presents this data.

Sociocultural research

The social and educational context of eating disorders and physical activity is also an important area for continued research attention. Many scholars who have focused on the significant incidence of disordered eating among active women agree that physical educators, fitness instructors and sports coaches are at the forefront of effecting change in this area [42, 43]. Ross [43] implicated physical educators as partly responsible for the prevalence of eating disorders among young, active girls and women because they often lack regard for an integrative approach to health and fitness:

> Physical education is dedicated to the improvement and enhancement of health and is primarily interested in prevention rather than cure… (Physical educators) must be extremely careful to avoid contributing anything which may induce anorexia or bulimia… Due to the close relationship physical educators have with their students they are in a privileged position to raise questions about all aspects of good health, including what constitutes good health practices [43; pp. 239-240].

In his article, Ross [43] called attention to the activity-based anorexia hypothesis [14]. In light of this theory, Ross proposed that educators pay special attention to the association between decreased caloric intake and increased exercise in students who are focused on weight loss.

Like physical educators, fitness instructors can also influence exercisers' attitudes towards weight loss, health and fitness. Lenskyj [44] speculated that instructors encounter a significant number of exercisers who suffer from eating disorders. As a result, she encouraged instructors to work towards changing dangerous weight control behaviours and women's attitudes about exercise as a weight loss tool. For example, instructors should emphasize fitness for health and fun not weight loss, initiate discussions on eating disorders and nutrition, and work to debunk the thin-equals-fit stereotype.

Physical educators and fitness instructors have the potential to effect change in educational/recreational settings. In the case of competitive sports, it is the coach who often exerts the most influence on the eating habits of young female athletes. Sundgot-Borgen [20] identified that a significant number of athletes who developed eating disorders had started dieting at an early age based on the recommendations of their coaches. Often coaches expect athletes to conform to a certain standard of body weight or fat composition [29, 44]. In turn, this type of rigid standardization can contribute greatly to an obsession with food and thinness for some female athletes [29]. Lenskyj [44] urged all coaches to discontinue overemphasizing weight, advising athletes that they will perform better at a lower weight, holding public weigh-ins, and humiliating athletes for not meeting (typically unrealistic) weight specifications. She also pointed out that female coaches may be most appropriate for encouraging the continued health of female athletes because "the values and priorities of the average male coach may be dramatically different from those of the girls and women he coaches" [44; p. 99].

Although a change in policy and attitude among physical educators, fitness instructors and coaches will contribute to a heightened awareness and prevention of disordered eating among active women, policy change from a wider perspective is equally essential. Lenskyj [44] insisted that "(a)ny recommendations addressing the problem of eating disorders among women who are competitive or recreational athletes need to take (a) social context into account" [pp. 107-108]. In other words, the values of a male-dominated society are reflected in women's sports and exercise; in turn, these values contribute to disordered eating patterns and body dissatisfaction. Athletic girls and women must challenge the emphasis on "win at all costs" in sport, and fitness as a means to an end: weight loss for the purpose of body beautification.

In general, sociocultural values and attitudes are transmitted (and constructed) through advertising and promotional materials. Galasso [42] associated eating disorders in active women with the manner in which fitness is promoted and advertised to the public.

> Professionals have a responsibility to provide information with respect to the dangers of overexercising and fat control. We need to create a balance in our promotional campaigns and to warn people of the potential outcomes and how to avoid them. It is not good enough to say that our job is motivation. We must assume responsibility for what is happening as a result of our promotional campaigns [42; p. 268].

5. Under-represented populations

In most cases, the subjects recruited for studies on exercise and eating disorders are either young adult or middle-aged men and women competitive runners [2, 3, 9] or university students and collegiate athletes [23, 25, 34]. There are few studies that address disordered eating among recreational exercisers and athletes aged 30 or older (other than competitive runners).

Research concerned with athletics, eating disorders, and race and ethnicity is also underdeveloped in the literature. Most of the studies cited earlier are comprised of samples that were primarily white, and in some cases the researchers failed to offer any race specifications. Other studies recruited some subjects who were black [10, 11, 24, 26], Hispanic [11] and Asian [22, 26, 45]. However, race diversification in most of these samples was very small.

The importance of considering ethnic diversity is evidenced in a study that uncovered racial differences in response to eating disorders and dance. Although the majority of female dancers in a study by Hamilton et al. [24] were white, data indicated that the black dancers did not suffer from disordered eating (whereas white dancers did). This finding suggests that race and cultural preference may play an important role in the development of eating disorders among athletes who participate in sports that typically require a very thin body aesthetic. Undoubtedly, more research in this area would be valuable.

Finally, there exists a gap in the literature with respect to ability, sexual orientation and socioeconomic status of female athletes and exercisers. There have been a few studies done on physical appearance and the effect on self-esteem, body image and eating behaviours in athletes with physical disabilities. With respect to children with disabilities, researchers have suggested that there is a “triple jeopardy” of eating problems related to the disability. Not only does physical activity impact on existing eating problems, but there are also disability-specific implications for eating problems and the role of cultural influences [46]. Apart from a few studies, the issue of disability and its relationship to eating disorders and physical activity has received little attention in the literature.

D. Summary

Based on the research to date, it is clear that there is an interdependent relationship between eating disorders and physical activity for girls and women in our society. Unfortunately, the nature of this relationship remains inconclusive. It is clear that eating disorders are common among female athletes, especially those who participate in aesthetically oriented sports such as gymnastics and individual sports such as running. Eating disorders are less commonly found in sports such as weight lifting, perhaps because these sports demand a less “feminine” physique. However, it is not clear whether it is participation in sport that causes the disordered eating patterns, or whether those girls and women who participate are predisposed to having an eating disorder.

It also appears that culture and ethnicity play a role in the relationship between eating patterns and physical activity; however the exact nature of this relationship is not clear. Some women who participate in recreational activity are prone to eating disorders, perhaps due to a strong focus on appearance. Some researchers suspect that long training hours, combined with a focus on physical aesthetics and performance, contribute to disordered eating among athletes. Other researchers believe that certain girls and women, who are predisposed to developing an eating disorder, tend to participate in sports that

trigger this phenomenon. Disordered eating among female athletes and recreational exercisers merits on-going research attention. More studies that deal with this widespread phenomenon will greatly contribute to the area of women's health research.

E. Gaps in the Literature

Research in the area of eating disorders and physical activity must expand beyond current horizons. Although continued attention to eating disorders among female athletes is valuable, a greater emphasis on eating disorders and recreational exercisers is overdue. In addition, studies that bring information to light about the relationship between eating disorders and exercise among under-represented groups are imperative for the evolution of the knowledge base in this area. More information is needed about the relationship between disordered eating and females living with disabilities, visible minorities, lesbians, children, older adults, and lower socioeconomic status girls and women.

As demonstrated in the literature review, there is an over-reliance on a quantitative research design. The inclusion of more qualitative research strategies designed to tap individual perceptions, as well as social and cultural norms and values, would make an important contribution to understanding the nature of the relationship between eating disorders and physical activity. However, employing qualitative measures is not enough. Qualitative findings must be adequately presented to the reader so that the individual voices of the female study participants can be recognized and valued. Further, supporting the health and well-being of active girls and women means interpreting qualitative data in light of social and cultural norms.

Finally, researchers have focused primarily on anorexia nervosa and bulimia with little regard for other forms of eating disorders such as overeating. Studies that consider a wide range of disordered eating and exercise behaviour, such as the relationship between disordered eating and resistance to exercise, are needed to help fill this gap in the literature.

F. Implications

1. Research recommendations

More research is required in order to further clarify the relationship between disordered eating and exercise. For example, studies should be expanded to include more qualitative research, and findings should include an adequate presentation of the data. Understanding the interdependent nature of physical activity and eating disorders would be greatly enhanced by the use of various qualitative research strategies to investigate individual perceptions and the implications of social and cultural norms and values. Qualitative findings should be presented in the context of the lives of girls and women. A greater emphasis should also be placed on revealing study participants' interpretations and viewpoints through their own words.

There also needs to be a heightened focus on disordered eating among women who exercise recreationally. For instance, group exercise is a logical focal point for ongoing research on women and disordered eating because this activity is popular among female recreational exercisers. Due to the fact that fitness classes are traditionally associated with image and appearance, increased research attention in this area is a necessary step towards an advancement in women's health and well-being.

It would also be valuable for researchers to expand the description of disordered eating and consider the relationship between physical activity and women who suffer from overeating and/or extreme resistance to exercise. This approach could enable investigators to develop a more complex understanding of the link between exercise and eating disorders, as well as to potentially prevent less damaging forms of disordered eating and patterns of activity/inactivity from becoming serious health concerns. This topic should also be extended to include a greater diversity of research populations by including girls and women who are living with a disability, visible minorities, lesbians, children, older and/or from a lower socioeconomic background.

Finally, researchers need to pay more attention to the development of policies and programs that enhance the exercise experiences for girls and women, as well as diminish the importance of weight loss. This requires studies to challenge the social norms associated with beauty ideals and sports competition, and to determine how various interventions can contribute to this challenge and support the well-being of girls and women in our society. To accomplish this, researchers must work with those people who share a responsibility for supporting and promoting health and well-being among active girls and women. By developing research strategies that include physical educators, fitness trainers and instructors, coaches, and the promoters and advertisers of fitness and health, researchers will be able to consider the complexity of the relationship between physical activity and eating disorders, as well as educate those who are in the best position to support positive body image, eating practices, and physical activity.

Suggested research questions

1. How can qualitative methodologies further the investigation of eating disorders and exercise among women?
2. What is the relationship between recreational activities and disordered eating among women?
3. Does the development (and severity) of an eating disorder differ between elite athletes and recreational exercisers?
4. How does one's struggle with overeating and/or exercise resistance affect exercise experience?
5. Does ability/cultural/racial/sexual/economic positioning influence women's experiences with disordered eating and exercise?
6. Do the existing eating disorder inventories address the specific issues relevant to various racial, cultural and economic groups?
7. What policy changes would be most effective in focusing attention away from weight loss and appearance enhancement in the physical activity setting?

2. Policy recommendations

In order to help prevent the incidence of eating disorders, policy makers and programmers must counteract the continued promotion of unhealthy images and messages. Harmful media images, and even messages transmitted by leaders in the fitness industry, have the potential to trigger eating and exercise disorders. Fitness advertising and media messages, should be encouraged to adopt a set of ethical standards, similar to the standards enforced for ethics in research. In particular, fitness advertising needs to be monitored in an effort to detect and prevent false claims about weight loss.

It would also be valuable if public policy included a strategy to communicate the dangers of overexercise and the pursuit of a thin ideal. This could take the form of media messages aimed at the general public, but should also include the targeting of fitness and health professionals. Health and fitness leaders need to understand the link between exercise and eating disorders, as well as be aware of the implications of the social and cultural context with respect to themselves and their clients. Finally, a university curriculum that pays special attention to educating students about the hazards of decreased caloric intake and overexercise would be beneficial.

It is crucial that policy change be directed at dissociating extreme thinness with the purpose of exercise, or one's ability to succeed in certain sports. Leaders in fitness (educators, instructors and coaches) are in a position to aid in the prevention of anorexia, bulimia and disordered eating among active girls and women. In addition, fitness professionals and facilities must refrain from making advertising claims that a socially defined "ideal" weight is a necessary component of being fit and healthy. Finally, policy makers must consider the interrelationship between active women's unhealthy relationship with food, their diminished power within a male-dominated society (and sports world) and cultural standards of female beauty which emphasize an ultra-thin physique.

G. Search Strategies

This literature review is based on three major search strategies: library database searches, identifying relevant material in the reference lists of articles obtained in the database searches, and searching for relevant articles in The International Journal of Eating Disorders, (1982-1997).

The library database searches were carried out on a number of databases to find relevant articles published in psychology, women's studies, exercise, sport, recreation, health and medical journals. These specific databases include:

- Women's Resources International 1972-9/1997
- Medline 1966-1997
- Psychlit 1974-1997
- Sportdiscus 1975-9/1997 and Heracles 1975-1995

Specific search terms (key words) included all combinations of the following two categories:

- physical activity, exercise, fitness, recreation, sport
- eating disorders, disordered eating, anorexia (nervosa), bulimia (nervosa), eating, overeating (binge-eating), nutrition

Because most of the research on disordered eating and sport/exercise has focused on female subjects, including specific searches for girls/women was not always necessary.

H. Literature Summary Tables

The following tables organize the literature reviewed with respect to eating disorders. Only those articles that investigated the relationship between physical activity and eating disorders specifically are included. Related reports and analyses can be found in the references section only.

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
American College of Sports Medicine [33]. The female athlete triad.	• literature review	N/A	• athletes (Female Athlete Triad)	• a discussion of the Female Athlete Triad and a call for more research in this area
Brooks-Gunn et al. [26]. Attitudes toward eating and body weight in different groups of female adolescent athletes.	• quantitative • survey design	• 161 female adolescent athletes (aged 14-18) • 3 black, 3 Asian, 155 white	• figure skating (n=25) • ballet (n=64) • swimmers (n=72).	• dancers & skaters had more negative eating attitudes than swimmers • low weights in dancers & skaters
Brownell, et al. [31]. Eating, body weight and performance in athletes.	• theoretical book	N/A	• performance athletes	• a book dealing with eating, nutrition, body image and eating disturbance in performance athletes
Chang, Blumental, O'Toole [4]. Running and anorexia revisited: an empirical study of obligatory running and anorexia nervosa.	• quantitative • MMPI	• 43 runners • 24 anorexia patients	• running program	• Runners did not suffer from the same degree of pathology as the eating disorder patients

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Chapman [41]. Making weight: Lightweight rowing, technologies of power, and technologies of the self.	• qualitative • interviews	• eight females (aged 20-26) • all white with some university education	• lightweight rowers	• theoretical conclusions
Coen & Ogles [3]. Psychological characteristics of the obligatory runner: A critical examination of the anorexia analogue hypothesis.	• quantitative • questionnaires • psychological scales	• 375 men • average age 44 • 96% white • average education 15 years	• marathon runners (obligatory vs. nonobligatory) • anorexia analogue hypothesis	• Obligatory Exercise Questionnaire shown to be valid and reliable • trait anxiety and perfectionism significant in obligatory runners
Crago et al. [21]. Height-weight ratios among female athletes: Are collegiate athletics the precursors to an anorexic syndrome?	• quantitative • review of college records from 1977-1982	• 384 female college athletes • average age 19	• 11 intramural sports	• height-weight ratios revealed no indication of eating disorders from 1977-82
Davis [18]. Body image and weight preoccupation: A comparison between exercising and non-exercising women.	• quantitative • questionnaires • psychological scales	• 86 regular female exercisers (average age 22) • 99 non-exercising women	• exercisers from various fitness and track clubs	• dedication to exercise may foster heightened narcissism and body image distortion
Davis & Cowles [27]. A comparison of weight and diet concerns and personality factors among female athletes and non-athletes.	• quantitative • Eating Disorder Inventory	• controls: 64 women • thin athletes: 64 • normal athletes: 62	• a variety of sports that emphasize thinness or a normal body build	• thin athletes had more diet and body image concerns than normal sized athletes
Davis et al. [35]. The functional role of exercise in the development of weight and diet concerns in women	• quantitative	• 112 regular female exercisers	• exercise classes and programs	• weight and diet concerns did not predict amount of physical activity. • regular exercise may be connected to diet and weight concerns
Davis et al. [19]. The role of physical activity in the development and maintenance of eating disorders.	• quantitative • qualitative (in-depth interviews)	• Study 1: 41 females (aged 18-27) • Study 2: 45 female eating disorder patients (under 35 years old)	• various athletes	• exercise may be related to eating disorders • sport/exercise is part of pathogenesis of disorder eating
Eisler & le Grange [15] Epling & Pierce [16] Epling et al. [14]	• quantitative • animal experiments	• rats	• activity-based anorexia hypothesis	• starvation may be linked to excessive exercise and eventual eating disorders

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Epling & Pierce [17]. Solving the anorexia puzzle: A scientific approach.	• theoretical book	• N/A	• activity-based anorexia	• a book dealing with anorexia and its association with physical activity
Galasso [42]. The ethics of eating and exercising disorders.	• theoretical paper	• N/A	• eating and exercise disorders in recreational exercisers	• recommendations for the alleviation of eating disorders in physical education
Gleaves et al. [7]. Bulimia nervosa symptomatology and body image disturbance associated with distance running and weight loss.	• quantitative • questionnaires	• 20 runners who had lost weight • 20 controls • 20 bulimic patients • (n=60 females)	• running	• no differences in control and runners • no support that weight loss through running increases body image/eating concerns
Hamilton et al. [24]. Sociocultural influences on eating disorders in professional female ballet dancers.	• quantitative • psychological scales	• 66 female ballet dancers (aged 20-35) • American & European • 55 white, 11 black	• ballet dance	• ethnicity related to eating disorders • black dancers more satisfied with body and less dieting than white dancers
Hamilton et al. [45]. The role of selectivity in the pathogenesis of eating problems in ballet dancers.	• quantitative • survey	• 32 white American dancers • 17 Chinese dancers • (n=49) female dancers	• ballet dance	• early selection of ballet dancers may create less risk for eating disorders because they are naturally slim • no significant difference in eating problems between Chinese and Americans
Holderness et al. [30]. Eating disorders and substance use: A dancing vs. a nondancing population.	• quantitative • psychological scales	• female dancers (n=50) • female nondancers (n=56)	• ballet dance	• eating disorders in these dancers show a profile different from nondancers with eating disorders
Kiernan et al [32]. Relation of level of exercise, age, and weight-cycling history to weight and eating concerns in male and female runners.	• quantitative • questionnaires • Eating Attitudes Test (EAT)	• n=2,459 men • n=1,786 women	• running	• high-mileage male runners had symptomatic EAT scores • level of exercise was not associated with EAT scores in women • history of weight-cycling may put runners at greater risk for eating disorder

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Lenskyj [44]. Running risks: Compulsive exercise and eating disorders.	• theoretical paper • literature review	• N/A	• sports • recreational exercise	• recommendations for decreasing the focus of body image and weight in sports and exercise • discussion of coach's role • exercise for large women
Manore [1]. Chronic dieting in active women: What are the health consequences?	• theoretical paper • literature review	• N/A	• various sports and exercisers	• a review of the possible health consequences of chronic dieting in active women
Martin & Hausenblas [37]. Psychological commitment to exercise and eating disorder symptomatology among female aerobic instructors.	• quantitative	• 286 female aerobics instructors • (mean age=34.1)	• aerobics	• instructors demonstrated healthy attitudes toward exercise and eating
Nudelman et al. [5]. Dissimilarities in eating attitudes, body image distortion, depression, and self-esteem between high-intensity male runners and women with bulimia nervosa.	• quantitative • Eating Attitudes Test (EAT)	• n=20 male runners • n=20 male controls • n=20 females with bulimia	• running (high-intensity) • anorexia analogue hypothesis	• high-intensity running in men is not analogous to eating disorders in women
Olson et al. [36]. Self-reports on the eating disorder inventory by female aerobic instructors.	• quantitative • Eating Disorder Inventory (EDI)	• n=30 female aerobics instructors	• aerobics/ aerobics instruction	• 40% of instructors indicated a previous experience with eating disorders • their scores on EDI similar to athletes in sports that emphasize leanness and to those who have eating disorders
Owens & Slade [8]. Running and anorexia nervosa: An empirical study.	• quantitative • questionnaire	• n=35 female runners • average age 29	• running • anorexia analogue hypothesis	• some superficial similarities between female runners and anorexics but, overall, no fundamental, causal similarities
Pasman & Thompson [11]. Body image and eating disturbance in obligatory runners, obligatory weight lifters, and sedentary individuals.	• quantitative • questionnaires	• 30 obligatory runners, 30 obligatory weight lifters, 30 sedentary controls • (n=90) • ages 18-60 • 15 men and 15 women in each group • 86 white, 2 black, 2 Hispanic	• obligatory running • weight lifting	• females more dissatisfied than males except weight lifters were equal • exercisers had more eating problems than controls • females more eating problems than males

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Parker et al. [9]. Psychological features of female runners presenting with pathological weight control behaviors.	• quantitative • psychological scales	• n=29 eating-disturbed runners • n=19 eating disorder patients • n=34 non-athletic, non-eating disorder controls	• college level distance running and cross-country running • anorexia analogue hypothesis	• pathological dieting found in some runners • only eating disordered group showed significant levels of psycho-pathology
Physical activity and sport in the lives of girls. [46]	• literature review	• girls	• physical activity • sport • exercise	• general
Richert & Hummers [34]. Patterns of physical activity in college students at possible risk for eating disorder.	• quantitative • Eating Attitudes Test (EAT)	• university students • 160 females • 185 males	• jogging	• a preference for jogging among subjects at risk for an eating disorder
Ross [43]. Eating disorders, physical fitness, persons and physical education.	• theoretical paper	• N/A	• recreational exercise	• a discussion of the present dissociation of mind and body among active people
Sundgot-Borgen [20]. Risk and trigger factors for the development of eating disorders in female elite athletes.	• quantitative -survey -Eating Disorder Inventory • qualitative -interviews	• n=603 elite female athletes in Norway • aged 12-35	• various sports	• 117 of the athletes were determined at risk for an eating disorder • eating disordered athletes began sports and dieting earlier than controls
Sykora et al. [25]. Eating, weight, and dieting disturbances in male and female lightweight and heavyweight rowers.	• quantitative	• n=82 heavyweight (male and female) • 80 lightweight (male and female) • n=162 rowers	• light and heavyweight rowing	• evidence of weight and eating disturbances in both genders and weight categories
Tobin et al. [13]. Divergent forms of purging behavior in bulimia nervosa patients.	• quantitative	• 240 bulimic females • 5 bulimic males	• exercise as a form of purging	• exercise was the second most used form of purging • 66% of patients reported exercising at least 30 minutes a day
Virnig & McLeod [22]. Attitudes toward eating and exercise: A comparison of runners and triathletes.	• quantitative • Eating Attitudes Test (EAT)	• 56 runners (34 male, 22 female) • 53 triathletes (42 male, 11 female) • 73% white, 16% Asian, Hispanic	• running • triathlons (swimming, biking, running)	• triathletes had slightly healthier attitudes towards eating than runners • females had more disordered eating than males but no evidence of risk for eating disorder

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Walberg & Johnston [28]. Menstrual function and eating behavior in female recreational weight lifters and competitive body builders.	• quantitative • survey	• 103 female weight lifters • 92 female controls • average age 18-24	• weight lifting • bodybuilding • (competitive and non-competitive)	• a large number of women who had a previous history with disordered eating engaged in weight lifting and competitive bodybuilding
Warren et al. [23]. Disordered eating patterns in competitive female athletes.	• quantitative • Eating Disorder Inventory (EDI) • Eating Attitudes Test (EAT)	• n=82 competitive female college athletes • n=52 controls • average age 19	• gymnastics • cross-country running • basketball • golf • volleyball • swimming • tennis	• no athletes had scores suggesting an eating disorder • all athletes reported normal weight and eating • runners may be at less risk for an eating disorder and gymnasts may be at a greater risk
Weight & Noakes [10]. Is running an analog of anorexia?: A survey of the incidence of eating disorders in female distance runners.	• quantitative • Eating Attitudes Test (EAT) • Eating Disorder Inventory (EDI)	• n=125 female distance runners • black and white • South African study	• marathon and distance running • anorexia analogue hypothesis	• low incidence of anorexia in this group of runners
White & Montell [40]. Identification and treatment of exercise resistance: A syndrome associated with eating disorders.	• qualitative • informal interviews	• n=60 women treated for overeating problems	• lack of recreational physical activity (exercise resistance)	• exercise resistance has negative consequences for women's health and is often associated with overeating
Yates et al. [2]. Running: An analogue of anorexia?	• quantitative -questionnaires • qualitative -interviews	• 60 male runners	• running	• obligatory male runners exhibit psychological and personality profiles similar to women with anorexia
Yates, A. [6]. Compulsive exercise and the eating disorders.	• book/ research review	• male runners and female anorexics	• running	• a book which overviews the similarities between obligatory running in men and female anorexia patients
Yates et al. [12]. Overcommitment to sport: Is there a relationship to the eating disorders?	• literature review	N/A	• various sports • obligatory exercise • anorexia analogue hypothesis	• a discussion of the analogy between compulsive exercise and eating disorders
Yeager et al. [29]. The female athlete triad: disordered eating, amenorrhea, osteoporosis.	• theoretical paper	N/A	• athletes • Female Athlete Triad	• a discussion of the Female Athlete Triad and a call for more research in this area

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IV. SMOKING CESSATION

Susan Crawford, PhD

A. Chapter Overview

What do we know?

There is a clear benefit of physical activity for general health and well-being, and physical activity has the potential to counter the negative health benefits of both smoking (such as heart disease) and smoking cessation (such as weight gain). For women who are in the process of reducing their consumption of cigarettes, or quitting altogether, physical activity contributes to feelings of well-being by reducing measures of anxiety and depression.

What do we need to research?

Despite the research that has been done, the following relationships remain inconclusive:

- The relationship between smoking and participation in physical activity.
- The relationship between smoking cessation and exercise.

The inconclusive nature of these relationships suggests that more research is needed. Our knowledge would also benefit by a closer examination of the reasons behind the concentration of smoking behaviours among those people with lower levels of income and education. Research into the role of physical activity as an adjunct to smoking cessation needs to investigate the independent roles of socioeconomic variables, such as education, income, isolation, and sense of control.

Finally, since smoking is an intransigent behaviour that is socially, behaviourally, and chemically reinforced, research into the role of physical activity in breaking the habit of smoking needs to consider measures of chemical, behavioural, and social constructs.

What should we do?

Physical activity should be promoted as a technique to enhance smoking cessation on the basis of its established benefits to physical, psychological, and social well-being.

Because of the promise of the initial findings of the stages of change research for understanding the relationship between physical activity and smoking behaviour, practitioners should consider employing measures of readiness, attitude, and self-efficacy towards both smoking and physical activity before engaging participants in programs that attempt to change these behaviours.

It is important that intervention programs recognize the environmental issues (i.e., low sense of control that predispose those in lower socioeconomic situations) that may work against an individual's attempts to change her behaviours. Both practitioners and policy makers must acknowledge this reality and work to ensure equal access to, and support for, healthy lifestyles and personal well-being.

B. Introduction

Cigarette smoking has been identified as the leading preventable cause of mortality in Canada and the United States [1]. The risk of dying from cardiovascular disease (CVD), the leading cause of death in North America, is 70% greater for smokers than non-smokers [2]. While premenopausal women, in general, have a lower risk of mortality from CVD than older women and men, women who smoke have similar rates of cardiovascular disease death to those of men who smoke [3]. Eighty per cent of lung cancer, the leading cause of cancer death among both men and women, is caused by cigarette smoking

[4]. The U.S. Centres for Disease Control [5] reported that the lung cancer death rate among women has increased by more than 400 per cent over the last 30 years and is continuing to rise. Tobacco use also has the potential to damage women's reproductive health, increasing the risk for infertility, complications of pregnancy, low birth weight and Sudden Infant Death Syndrome in offspring, and early menopause [5].

This bleak picture is further complicated by the estimate that young women are taking up smoking at a faster rate than are young men [6], and that smoking cessation rates are lower among women than men [7]. The one-year quit ratio for men and women combined is less than 1% [6]. It has also been suggested that women experience a greater relapse rate than do men [7-9]. Marcus, King, Albrecht, Parisi, and Abrams [10] have suggested that weight control may be a primary motivator for smoking continuance and may contribute to relapse among women. Smoking and physical inactivity are also among the behaviours that tend to cluster within certain subgroups of the population. Both are more common among those with lower incomes and the least education [6, 11-13].

Fortunately, recent research indicates physical activity may be an effective strategy both to support the health of the individual [8, 14], as well as to assist with the reduction or cessation of tobacco use [10, 15, 16]. These findings are further supported by research related to other psychoactive drugs, including illicit street drugs such as cocaine and heroin, prescription drugs such as tranquilizers and sedative-hypnotics, and those drugs found in substances commonly consumed by adults in Western societies, namely, caffeine, nicotine, and alcohol. Although the prevalence of illegal drug use among women is not known, usage of legal substances is a particular problem for women. Women now constitute about half of all alcoholics and outnumber men in the use of tranquilizers by 2.5 to 1 [17].

For a number of reasons, physical activity is considered a logical adjunct to the reduction or cessation of psychoactive drug use. Psychoactive drugs, including tobacco, alter brain function in ways that temporarily change mood, thought, feeling or behaviour [2]. Affecting the same neural systems as psychoactive substances, physical exercise has the potential to serve as a substitute in the dopaminergic reinforcement mechanism through the release of endorphins and catecholamines [18, 19]. Physical activity has also been suggested as a potential modulator of the mood changes that can occur during withdrawal from substance use [18-20]. In addition, the increase in sense of mastery associated with exercise may encourage individuals to maintain abstinence [18]. Finally, in the case of cigarette smoking, physical activity is potentially beneficial in the attenuation of weight gain that often occurs with smoking cessation [8, 21, 22].

C. Literature Review

The following review is organized around four primary research areas that are relevant to understanding the relationship between physical activity and smoking cessation. The first grouping of studies addresses interventions in which physical activity was used in the treatment of inpatients of substance abuse rehabilitation programs. This section is followed by a review of studies investigating the effects of exercise as an adjunct to smoking cessation. The third body of research deals with prospective secondary data analyses that have investigated the association of adopting or maintaining physical activity with weight gain following smoking cessation in women. And finally, the concluding section deals with the cross-sectional examination of the cognitive-behavioural and motivating factors associated with both exercise participation and smoking.

1. Substance abuse rehabilitation

In two recently published papers, Palmer and colleagues examined the effects of exercise training on mood, state-trait anxiety, depression, and other psychological variables with respect to rehabilitation from psychoactive drugs other than nicotine [18, 23]. The most recent study reported on a program that employed both aerobic exercise and weight training in the rehabilitation of adult inpatients with alcohol, cocaine or other drug problems [23]. While measures of physical fitness did not improve over the four weeks of the intervention, significant reductions in depression scores among the weight training sub-group were observed. This was a mixed-gender sample that included only 11 women whose data were not reported independently.

The earlier study by the same lead investigator demonstrated that an exercise program consisting of walking or jogging three days a week throughout a 28-day inpatient alcohol-abuse treatment program significantly improved state anxiety, trait anxiety and depression, but not self-concept or aerobic capacity [18]. As for the more recent study described above, the results for the women (n=16) and men (n=37) who participated in this study were not reported separately. This is problematic in that research has demonstrated women have certain unique physical and physiological responses to psychoactive drugs [24]. A better understanding of these differences between men and women would help to build informed hypotheses about the potential role of physical activity in attenuating problematic drug use.

2. Exercise as an adjunct to smoking cessation

In cross-sectional studies, cigarette smoking has been found to be associated with a sedentary lifestyle or lack of physical activity in both women and men [21, 22, 25, 26]. However, other authors have reported no association, or only a modest inverse association, between smoking and physical activity [27, 28]. A recent cross-sectional study of 1,324 postmenopausal women [25] suggested that while those who had never smoked were significantly more likely to participate in “working-out” (presumably gym-related activities such as aerobics and weight training), smokers and never-smokers did not differ in sports participation or walking. Brown and colleagues [20] examined activity and smoking data from a mixed gender sample of healthy subjects in the first National Health and Nutrition Examination Survey (NHANES I) Epidemiologic Follow-up Study (n=1,317). These authors reported that the prevalence of high, moderate and low physical activity did not differ by smoking status. However, if subjects who had established health problems had been included a difference may have been detected. Because it is likely that those with health problems are among the less active and are predominantly smokers, including those with health problems may have indicated that the non-smokers were more active.

For this review, only six published studies were uncovered that examined the contribution of physical activity to smoking cessation. It is of interest that only one study used an exclusively male sample, one study followed a mixed group of volunteers, and the remaining four studies focused solely on women. This is largely due to the fact that three of the studies originated from the same research group.

What appears to be the first published experimental evidence of the effects of exercise on smoking cessation involved 26 female and 10 male adult volunteers [29]. The randomly assigned control group received group counseling for smoking cessation twice weekly for five weeks. The experimental group underwent the same counseling program followed by an additional 30 minutes of aerobic exercise over the same time span. This group was also encouraged to participate in self-directed physical activity throughout the duration of the project. No baseline between-group differences in physiological or psychological parameters were observed. While both groups experienced significant reductions in smoking behaviour over the duration of the program, significant recidivism also occurred in both groups over the following six months. There were no statistically significant differences in smoking behaviour at the six-month follow-up, even though more subjects from the exercise group had quit smoking. No specific data were reported on the effects of exercise on the women smokers in this study.

Russell and colleagues [19] compared the effects of a six-week program of physical activity with an educational and relaxation program on long-term abstinence in 42 women smokers. The results indicated that there were no benefits of participating in the 10-week exercise program in terms of long-term abstinence or in changes in mood. In fact, at the six-month follow-up it was found that those who participated in the exercise intervention scored significantly higher on the tension-anxiety sub-scale of a mood state questionnaire than those in the educational or contact control groups. It was suggested that the challenge of changing simultaneously two behaviours (both of which are difficult enough to change individually) may have contributed to the increase in negative affect. The failure of those who received the exercise program to increase their level of fitness also suggested limited compliance to physical activity outside the six-week intervention. This may have contributed to the failure of the intervention to provide the benefits hypothesized.

Through a series of studies on smoking cessation, Marcus and her colleagues have attempted to demonstrate the efficacy of physical activity as an adjunct to programming for women [10, 15, 16]. In the earlier, exploratory works [15, 16], young and middle-aged women were randomly assigned to either an expert-led behaviour modification program for smoking cessation or an identical program with the addition of supervised aerobic exercise training. While abstinence appeared to be greater among those who participated in the exercise intervention, the group sample sizes were small (n=10), and relatively few women were successful at cessation and abstinence. As such, statistical significance was not achieved. The design problems of the first study [15], in which the exercise subjects had greater researcher contact as a result of the physical activity program, were corrected in the second study [16].

The design and baseline data for a much larger randomized controlled clinical trial comparing the relative efficacy of cognitive-behavioural smoking cessation treatment plus exercise with the same treatment plus contact control are described by Marcus and colleagues in their most recent study [10]. While results of this study have yet to be published, it appears that many of the design flaws of previous works have been recognized and controlled for in this project. Specifically, a large sample size will offer greater statistical power, in that 281 healthy sedentary women who smoke were randomly assigned to the two conditions. Minority and low-income women were also actively recruited. The study design also acknowledged the Hawthorne effect, and controlled for the additional contact time received by the exercise group. An extensive battery of psychological and behavioural measures related to smoking, diet and exercise were administered. Stages of change, or readiness measures for exercise participation and smoking cessation behaviour were assessed using standard scales. Data on eating habits, dietary restraint, weight concern, and weight gain history were recorded. Physiological estimates of peak VO_2 were obtained through a standard cycle ergometry protocol. Self-reported physical activity was also recorded.

3. Exercise in the attenuation of weight gain associated with smoking cessation

The fear of weight gain following smoking cessation appears to be particularly relevant for women smokers [10]. A recent study by Kawachi and colleagues [8] examined whether physical activity minimized weight gain after smoking cessation in a cohort of 9,306 women registered in the Nurses' Health Study [30]. Through a two-year follow-up period those who continued smoking and maintained their baseline levels of physical activity were compared with those who stopped smoking and either maintained, or increased their participation in physical activity. When potential confounders such as baseline weight and physical activity, previous changes in weight, age, and calorie, alcohol and fat intake at baseline were controlled for, the authors found that increasing physical activity at the same time as smoking cessation attenuates the weight gain normally experienced.

Adjusted models showed that previous smokers who did not increase their physical activity gained on average 2.3 kg if they were light smokers, and 4.5 kg if they had smoked more than 25 cigarettes daily. Those who increased their physical activity, gained significantly less weight, especially if they exercised more that two hours per week. Both previously light smokers and previously heavy smokers who increased their levels of vigorous physical activity by 1-2 hours per week gained significantly less weight (1.8 kg and 3.9 kg, respectively). If exercise participation exceeded two hours per week, weight gain was even less (1.3 kg and 2.9 kg, respectively).

The authors also examined the predictors of smoking cessation including age, baseline weight and intensity of smoking, but unfortunately failed to consider the effects of baseline exercise levels as a predictor of cessation. Only the amount smoked predicted cessation, in that those women who smoked fewer than 25 cigarettes per day were more likely to quit over the two-year observation period [8].

4. Cognitive-behavioural mediators of changing exercise and smoking behaviours

It is evident from the above studies that more information on the process of simultaneously changing smoking and exercise behaviour must be acquired. In an effort to understand the relationships among specific cognitive-behavioural and motivational mechanisms known to mediate smoking and exercise behaviour change, King and colleagues [31] undertook a descriptive study of 126 adult female and 206 adult male smokers. Smoking behaviour measures included abstinence self-efficacy, decisional balance

(pros and cons of smoking) and readiness to quit (stages-of-change) [32]. Measures of exercise behaviour included stages-of-change, exercise self-efficacy, and exercise decisional balance (pros and cons of exercising). MANOVA with the Tukey procedure for post hoc analyses were used to describe the relationships among the measured variables. None of the data was analysed by gender.

The results showed that significant associations existed among cross-behavioural variables. As might be expected, the more negative a smoker rated his or her habit, the more positive she or he rated the benefits of physical activity. Similarly, those smokers who reported strong positive aspects of smoking tended to rate highly the problems associated with exercising. Self-efficacy for exercising was significantly associated with that for refraining from smoking. In fact, those smokers who were regularly exercising reported significantly more confidence in their ability to refrain from smoking than those who were in the preparation stage for exercise. While stage of change for one behaviour was not significantly associated with the other, smokers who had already started to take action to change this behaviour were more confident in their ability to exercise than those who were preparing to quit or cut-down [31].

This study demonstrated the interconnections between changing exercise and smoking behaviour. The cognitive-behavioural and motivational factors associated with one behaviour were significantly associated with the other. This suggests that while self-efficacy is a behaviour-specific construct, it may be transferable to a second, complementary behaviour. Similarly, attitudes about and confidence for changing smoking behaviour appear to be related to an individual's motivation to change exercise behaviour.

Noting that these are associations and not causal relationships, the authors offered a number of suggestions about the mechanisms that might underlie these links: there may exist a general readiness for change; progressive changes in one behaviour precede and possibly inspire changes in a second behaviour; change process for individual behaviours are discrete and have no influence on each other [31].

This study suggests that multiple behaviour change may be a feasible route toward health improvement, and that smoking and exercise might be perceived as behaviours that are complementary or in which synergistic changes may operate. At the same time it is clear that the relationships between the two behaviours are quite specific to readiness for change and self-efficacy, as well as attitudes and expectations associated with the changes in behaviour. Unfortunately, there have not been many studies that consider the enormous complexities of replacing a habitual behaviour (and one that generally carries physiological dependence), with an entirely new behaviour.

Exploring the relationship between physical activity, smoking and behaviour change could be significantly supported by recent research that has examined the process of changing single behaviours and has found that individuals may progress and regress through a series of discrete stages [32]. Prochaska and colleagues [32] argue that each stage of change represents a different level of readiness or preparation to make the behaviour change. Different intervention strategies are therefore applicable to different stages. However, none of the intervention research currently available has taken into consideration the readiness of the subjects involved to either quit smoking, nor take up physical activity. Presumably all the research participants were volunteers in a smoking-cessation program and were therefore likely to be at least contemplating changing smoking behaviour. Unfortunately, it is impossible to estimate subjects' readiness to exercise either during or after these trials.

Similarly, few studies have examined self-efficacy or attitudes towards the behaviour changes they were encouraged to undergo. A clearer understanding of these variables may be able to shed some light on the reasons for the failure of the behaviour change process. The study described by Marcus et al. [10] is promising in that it takes into consideration the work of Prochaska and colleagues [32], and King and colleagues [31], and has included appropriate measures of readiness along with other important cognitive-behavioural and motivational variables. In practical applications and in future research, these parameters must be measured in advance of any intervention.

D. Summary

With respect to the adoption and maintenance of smoking behaviours, smoking and participation in lifestyle and leisure physical activity do not appear to be related, although this relationship is inconclusive. The relationship between exercise and smoking cessation also appears to be inconclusive. The evidence indicates that there is a clear benefit of physical activity for general health and well-being, and that therefore it is likely physical activity has the potential to counter the negative health effects of both smoking (such as heart disease) and smoking cessation (such as weight gain). In fact, for those women who are in the process of reducing their consumption of cigarettes, or quitting smoking altogether, physical activity does appear to contribute to feelings of well-being by reducing measures of anxiety and depression. However, this does not seem to be related to an increase in fitness level, but rather to the performance of the activity itself.

Researchers have speculated that based on physiological changes, physical activity has a logical role in helping women reduce or arrest their use of psychoactive substances such as tobacco. However, exercise appears to be most important in assisting with quitting in the short term as it does not seem to prevent long-term recidivism. This may be due to the complexities of replacing a habitual behaviour and/or changing the two separate but related behaviours of smoking and exercise simultaneously. Theories related to stages-of-change show considerable promise in helping to support both smoking cessation and increased physical activity levels, although more research that considers the application of these theories to both smoking and physical activity behaviours and the relationship between them is needed.

E. Gaps in the Literature

The inconclusive nature of the research with respect to the relationship between physical activity and the adoption and maintenance of smoking behaviours suggests that this area needs considerably more attention. The current literature offers only a rudimentary understanding of the relationship between exercise and smoking behaviours. It is not clear whether they are complementary, as suggested by King and colleagues [31] due to the preliminary findings that attitudes and self-efficacy for smoking cessation and participation in exercise appear to be correlated, or if individuals independently alter their attitudes and beliefs about these behaviours, as well as their readiness to change them. It is anticipated that the results of the current study by Marcus and colleagues [10] will shed some light on these issues.

Research would also benefit by a closer examination of the reasons behind the concentration of smoking behaviours among those people with lower incomes and education. While the reasons for this are complex, it is important that intervention programs recognize the environmental issues that may work against an individual’s attempts to change her or his behaviours. Research into the role of physical activity as an adjunct to smoking or drug use cessation also needs to investigate the independent roles of socioeconomic variables, such as education, income, isolation, and sense of control.

The experimental exploration of the use of physical activity as an adjunct to drug and alcohol rehabilitation and smoking cessation is relatively new, and as a result there are a number of basic gaps in the literature that need to be addressed as soon as possible. For example, further research in this area will require much larger cohorts than those in previous studies in order that the benefit of any intervention might reach statistical significance. The research that has examined the role of physical activity in rehabilitative programs for inpatients has also demonstrated the importance of measuring psychological outcomes in the long term, rather than in the short term only, as is the case for the studies cited here. In addition to psychological parameters, it is important that studies examine long-term effects of physical activity on abstinence and recidivism for both tobacco use and the use of other psychoactive drugs and alcohol. Unfortunately, studies to date have not been able to demonstrate that physical activity is a beneficial adjunct to cessation of psychoactive drug use and subsequent abstinence in either women or men.

Research into the role of physical activity in breaking the “habit” of smoking also needs to consider measures of chemical, behavioural and social constructs. Although the relationship between exercise

adoption and smoking cessation is poorly understood, it is clear that cigarette smoking is a largely intransigent behaviour because it is chemically, behaviourally, and socially reinforced. As a result, it needs to be considered from each of these three perspectives to assess whether physical activity can assist in reducing the power of these rewards. This approach would also result in a better independent understanding of the physiological, psychological, and social effects of different exercise modalities on brain function, mood, self-esteem, and self-efficacy. The identification of the potential means by which physical activity might contribute to the cessation of smoking and drug use in general could also assist in clarifying the potential for exercise to be an effective adjunct for the cessation of some drugs over others.

Finally, it is important to consider more carefully the uniqueness of women's physical and physiological responses to psychoactive drugs. Considering physiological difference, as well as the social and cultural context of tobacco use by women in our society, could help to develop informed hypothesis about the potential role of physical activity in attenuating problematic drug use. While no one can deny the health benefits of physical activity, physiological dependence and environmental factors are bound to heighten the challenges facing women who are attempting to change their drug use and exercise behaviours.

F. Implications

1. Research recommendations

At the most general level, on-going research into the relationship between physical activity and smoking cessation needs to emphasize large-scale case-control investigations among those who have successfully quit, and should reproduce promising small-scale studies such as Marcus and colleagues [10] with larger subject cohorts. The development of prospective studies exploring the strength of participation in physical activity to predict successful cessation of drug or tobacco use would also make an important contribution to the knowledge in this area. This could be greatly enhanced by the funding of large-scale studies on the role of non-pharmacological interventions into smoking and drug abuse cessation.

With respect to physical activity specifically, it is important that research continue into the physiological, psychological, and social effects of different exercise modalities on brain function, mood, self-esteem, and self-efficacy. This is especially important in light of research findings that indicate smoking practices vary according to education and socioeconomic status, as well as gender. Researchers must ensure that all studies include independent analyses by gender, as well as other diversity parameters such as age, ethnicity, sexual orientation, ability and socioeconomic status to allow for the examination of similarities and differences.

Finally, consideration of the social and environmental context is crucial to understanding the relationship between physical activity and smoking cessation. It is important that researchers identify the roles of physical, psychological and social environments in the capacity of individuals to take up physical activity in order to reduce drug or tobacco use. Identification of environmental factors that mitigate against cessation of drug use as well as maintenance of physical activity would also make an important contribution to this area.

Suggested research questions

1. Why does physical activity seem to contribute to short-term but not long-term smoking cessation?
2. What is the relationship between physical activity and cessation of smoking in comparison to other psychoactive drugs?
3. Is readiness for change in smoking behaviour related to readiness for change in exercise behaviour and/or vice versa?
4. What environmental (social, cultural, physical) factors enhance and/or inhibit smoking cessation behaviour for women?

2. Policy recommendations

Until more conclusive research is published in this area, it is recommended that physical activity be promoted as a technique to enhance smoking cessation on the basis of its established benefits to physical, psychological, and social well-being. Exercise is also important for those women who are concerned about weight gain during smoking cessation and should be recommended on the basis of its ability to attenuate weight loss. However, beyond general health and weight management benefits, drug abuse/smoking cessation and physical activity practitioners should not make claims about the benefits of physical activity as an adjunct to cessation or maintenance.

Although the research related to stages-of-change is still in the exploratory phase, the findings show significant promise for understanding the relationship between physical activity and smoking behaviours, as well as behaviour change strategies. As a result, practitioners should consider employing measures of readiness, attitude and self-efficacy towards both smoking and physical activity before engaging participants in programs that attempt to change these behaviours. This will enable drug abuse/smoking cessation and physical activity practitioners to better evaluate and understand the outcomes of their interventions, especially if they work in cooperation with each other, focusing on their own area of expertise when involved in programs that combine physical activity and rehabilitation.

Finally, smoking cessation strategies must be developed with consideration of environmental factors, such as low sense of control, that appear to predispose those in lower socioeconomic situations to use psychoactive substances and to not participate in high levels of physical activity. Both practitioners and policy makers must acknowledge this reality and work to ensure equal access to, and support for, healthy lifestyles and personal well-being.

G. Search Strategies

The literature search strategy for this review covered a range of substance-related disorders, including general disorders, alcohol, and cigarettes. The library database searches were carried out on two primary databases to find relevant articles published in psychology, addiction, exercise, sport, recreation, health and medical journals. Articles selected for review included those written in English only. The specific databases include:

- Medline 84-89; 89-94; 95-98
- Psychinfo (80-98)

Specific search terms (key words) included all combinations of the following categories:

- tobacco use disorder, smoking, substance-related disorders, ethanol, addiction, alcohol
- exercise, physical fitness, leisure activities, physical activity
- women, female

This comprehensive search of the medical (Medline) and psychological (Pychinfo) literature over the past 18 years revealed that, with the exception of smoking, remarkably little published work has examined the effect of physical activity on the cessation of psychoactive drug use in any population, much less women. Many of the studies identified in the literature search examined the association of physical activity with a number of other lifestyle behaviours in women, such as smoking, alcohol consumption, and diet, along with psycho-social parameters such as personality, stress and socialization. As the purpose of this review was to examine the health benefits of exercise, it was felt that these cross-sectional descriptions were not illuminating, and so were not included.

H. Literature Summary Tables

The following tables organize the literature reviewed with respect to smoking cessation. Only those articles that investigated the relationship between physical activity and the use of psychoactive drugs specifically are included. Reports and analyses that deal with more general factors such as tobacco use and health consequences, can be found in the references section only.

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Hill [29]. Effect of a program of aerobic exercise on the smoking behaviour of a group of adult volunteers.	• intervention	• women (n=26) • men (n=10) • smokers	• 30 minutes aerobic activity • twice weekly • for 5 weeks.	• exercise group had (non-significant) a greater abstinence rate at one, three and six months
Kawachi et al. [8]. Can physical activity minimize weight gain in women after smoking cessation?	• prospective cohort	• Nurses Health Study • smoking sub-sample (n=9,306)	• self-reported physical activity	• weight gain with smoking cessation significantly lower among women who increased physical activity over two years
King et al. [31]. Cognitive-behavioral mediators of changing multiple behaviors: smoking and a sedentary lifestyle.	• observational cohort	• adult smokers • women (n=126) • men (n=206)	• Measures of: • decisional balance • stages of change • exercise self-efficacy	• smoking and exercise are complementary behaviours
Marcus et al. [15]. Usefulness of physical exercise for maintaining smoking cessation in women.	• intervention	• healthy sedentary women smokers (n=20) • 20-50 years of age.	• 15-week modest to high intensity aerobic program • 45 mins./day • 3 times/week	• exercise group had (non-significant) greater abstinence rate at seven-day, one, three, and 12 months
Marcus et al. [16]. Exercise enhances the maintenance of smoking cessation in women.	• intervention	• healthy sedentary women smokers (n=20) • 22-56 years of age	• 15-week modest to high intensity aerobic program • 45 mins./day • 3 times/week	• exercise group had (non-significant) greater abstinence rate at one, three and 12 months
Marcus et al. [10]. Rationale, design, and baseline data for Commit to Quit: an exercise efficacy trial for smoking cessation among women.	• intervention (description of program, study design, and baseline data only)	• healthy sedentary women smokers (n=281) • 18-65 years of age.	• 12-week aerobic exercise program • self-reported physical activity • $\%VO_2max$	• project results not yet published
Palmer et al. [23]. Effects of type of exercise on depression in recovering substance abusers.	• intervention	• women (n=11) • men(n=26) • adult inpatients in drug rehabilitation program	• four-week program • weight training • circuit training • aerobic exercise	• greater reduction in depression scores among those who weight trained • no analyses by gender

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Palmer et al. [18]. Adult inpatient alcoholics: physical exercise as a treatment intervention.	• intervention	• women (n=16) • men (n=37) • inpatients in alcohol rehabilitation program	• aerobic exercise • 3 sessions per week • 30 minutes each session	• significant improvement on state and trait anxiety, and depression scores in group receiving exercise program
Perkins et al. [22]. Weight gain following smoking cessation.	• observational • prospective: 3 year follow-up	• women • current smokers (n=143) • ex-smokers (n=121) • never smokers (n=224) • 42 to 50 years of age	• self-reported physical activity	• current, but not former smoking associated with physical inactivity • recent ex-smokers increased physical activity over the three years
Russell et al. [19]. The effects of physical activity as maintenance for smoking cessation.	• intervention	• women smokers (n=42) • mean 28± 7 years of age	• aerobic exercise • 70-80% maxHR • 3x per week • 6 weeks	• physical activity program conferred no benefit in abstinence over 18 months

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V. CARDIOVASCULAR DISEASE

Susan Crawford, Ph.D.

A. Chapter Overview

What do we know?

Physical activity imparts a degree of protection against the risk of cardiovascular disease (CVD) mortality in women, while a physically inactive lifestyle may increase the relative risk for CVD for women.

Exercise is important for controlling lipid profiles in younger (premenopausal) women, and can contribute to management of central adipose stores. Finally, physical activity attenuates the abnormalities associated with hypertension and glucose intolerance, both of which are linked with CVD.

What do we need to research?

Additional research is needed that is centred specifically on the physiological and lifestyle aspects of women, in fact, few studies have been designed to investigate the relationship between physical activity and CVD in women only.

There is also a lack of long-range prospective and intervention studies designed specifically for women. This type of research would shed light on the frequency and type of activity necessary for risk reduction among women. Finally, researchers have not paid enough attention to population diversity among women. More studies that include older women, ethnic minorities, and women living in poverty, whose CVD morbidity and mortality are high, are required.

What should we do?

Given the preponderance of research supporting the role of physical activity in all-cause mortality, disease prevention, and improved overall health, women of all ages should be encouraged to increase their relative levels of participation in physical activity. In so doing, there is the potential for a substantial impact on women's experiences of cardiovascular disease morbidity and mortality.

However, there is a widespread prevalence of sedentary lifestyles in women. It is therefore an important yet challenging task to enhance physical activity opportunities and options for girls and women. Suggested routes for regular physical activity include: school physical and health education classes, local recreation centres, private health clubs, and local and provincial sports and recreation leagues. Given women's diversity, the limited range of opportunities for girls and women to get involved, and the number of sedentary females, it is important to continually develop opportunities for women and girls to become physically active.

B. Introduction

Cardiovascular disease (CVD) is this country's leading cause of death for both men and women [1] and accounts for more hospitalizations than any other illness [2]. While traditionally perceived as an affliction of middle-aged males, CVD is responsible for a greater proportion of total mortality among women (39%) than men (36%) [3]. Evidence of CVD is relatively rare among young and middle-aged women. However, for those women over the age of 65, clinical signs are present in one out of every three women [4]. Comparing the lifetime risks for common medical problems among postmenopausal women, Wenger noted that risk for CVD is 31% in contrast to 2.8% for hip fracture, 2.8% for breast cancer, and 0.7% for endometrial cancer [4].

Prevention of CVD in women is of critical importance. Gender differences in manifestation and outcome of CVD are now recognized. Morbidity from myocardial infarction is greater for women than men and nearly 40% of all coronary events in women are fatal [4]. Sixty-seven per cent of all sudden deaths involve those who have not previously been diagnosed with CVD [4].

The strongest CVD risk factors for women are advancing age, cigarette smoking, and Type 2 diabetes mellitus, with the latter two imparting greater relative risk for CVD on women than on men [5, 4]. Overweight and hypertension impart similar risks on both sexes, and the risk of elevated total cholesterol is slightly greater for men than women [4]. Sedentary lifestyle or physical inactivity is considered to be a major modifiable risk factor for heart disease in both men and women. The mechanisms by which physical activity offers protection against CVD include its direct effects on cardiovascular function and its role in attenuating other risk factors (Table 1.0).

TABLE 1.0– Proposed Mechanisms by which Physical Activity Provides Protection Against CVD.

Direct effects on cardiovascular system:

- Improves myocardial circulation and metabolism to protect the heart from hypoxic stress; this includes enhanced vascularization, as well as modest increases in cardiac glycogen stores and glycolytic capacity that could be beneficial when the heart's oxygen supply is compromised.
- Enhances the mechanical or contractile properties of the myocardium to enable the conditioned heart to maintain or increase contractility during a specific challenge.
- Establishes a more favourable neural-hormonal balance to conserve oxygen for the myocardium.

Effects on risk factors:

- Normalizes the blood lipid profile.
- Favourably alters heart rate and blood pressure so the work of the myocardium is significantly reduced at rest and during exercise.
- Favourably alters body fat distribution.
- Favourably alters glucose tolerance and insulin sensitivity.
- Possibly establishes more favourable blood clotting characteristics and other hemostatic mechanisms.
- Provides a favourable outlet and response pattern to psychologic stress and tensions.

Adapted from: McArdle W., Katch F., Katch V. Exercise Physiology: Energy, Nutrition, and Human Performance. 3rd Edition. Lea & Fibiger. 1991.

While it may not rank among the most potent of risk factors, physical inactivity is believed to be the most prevalent risk [6]. Remarkably, few women recognize its status as a risk factor. MacDonald reported that only 41% of adult women asked to list risk factors for CVD, identified physical inactivity [7].

Along with its primary preventive role in the etiology of CVD, physical activity is critical in the rehabilitation of individuals who have experienced an acute incidence related to CVD, and in the secondary prevention of further disease development. However, these issues will not be addressed here as the purpose of this review is to focus exclusively on the role of physical activity in the primary prevention of CVD in women. A comprehensive description of the pathophysiology of CVD along with the specific mechanisms by which individual risk factors influence the progress of the disease is also beyond the scope of this review. Those risk factors that appear to have links to physical activity (including dyslipidemia, hypertension, obesity with central distribution of body fat, and glucose intolerance with insulin resistance) are described in the context of their proposed role in reducing CVD risk in women. The interactions of physical activity with other risk factors such as smoking, stress, poverty, and sense of control are addressed to some extent elsewhere in this review series (see Chapters 1 and 2).

C. Literature Review

Three previously published reviews of the research on the benefits of physical activity on coronary heart disease (CHD; a specific presentation of CVD); CHD risk and CHD risk factors in women were identified

[6-8]. Together, these provide a broad perspective of the research up to 1996 and should be referred to by those interested in this area of inquiry.

1. The association of physical activity with CVD mortality in women

A majority of the large-scale epidemiologic and prospective studies that included investigations into the association between exercise and CVD (for example the Harvard Alumni Study and the MRFIT) have focused primarily on men [9]. Of the reports that have included women, a number have come out of the Cooper Institute using data collected in the 1970s and 80s [10, 11]. While the authors and sample sizes have varied, similarities in research protocol and the years during which the studies were conducted suggest that there might be considerable duplication of subjects in the various studies. In much of this work, the small numbers of CVD deaths among the young and middle-aged women made it difficult to reach statistical significance for a number of measures. As a result, all-cause mortality was generally used as the dependent variable.

More recent epidemiological studies conducted by Folsom and colleagues [12] and Kushi and colleagues [13] have included larger sample sizes, as well as older women. Folsom and colleagues [12] highlighted many of the shortcomings of the research in this area:

> We know of 12 epidemiological reports from 10 studies of physical activity and CHD that have reported results for women separately. Although all had few CHD events in women, six of the 10 demonstrated, at least univariately, that physical activity was associated statistically significantly with at least one CHD endpoint. Only six of these 10 studies were prospective, of which only three had validated CHD incidence endpoints [12; p. 906].

In one of the few large prospective studies on physical activity and mortality that have included women, Blair and colleagues [11] followed 3,120 healthy, educated, middle-class women (along with three times as many men) for an average of eight years, accounting for 25,433 women-years. Both physical fitness and level of physical activity were assessed at baseline, and all-cause mortality data were collected. A strong association between relative risk for all-cause mortality and level of physical fitness was reported for both women and men. The rise in relative risk associated with low levels of fitness was greater for women than for men. Women in the lowest tertile for physical activity had an all-cause mortality risk of 5.25 compared to the reference risk of one for the women in the highest tertile. By comparison, the relative risk for sedentary men was only 3.16. Mortality rates for CVD showed gradients similar to those for all-cause mortality across fitness levels in women as well as men. While there was also an association between relative risk and physical activity for men, there was none for the women in this study.

In a second study by Blair and colleagues [14], a cohort of 7,080 women (and 25,341 men) was followed for an average of 8.4 years to assess the influence of physical fitness on all-cause and CVD mortality. They noted that the small number of CVD deaths among the sample of women (who were between the ages of 20 and 88 years at baseline) resulted in low statistical power and fewer significant results than observed in associations with all-cause mortality. For example, while low fitness and smoking were related to all-cause mortality in women, only abnormal ECG and elevated fasting glucose reached significance as risk factors for CVD deaths in the female cohort. Of specific interest in this study was the finding that low fitness imparted a higher relative risk for CVD on women than did smoking (whereas the risk differential was not as great among men). It was also noted that women (and men) in the fittest quintile (by estimated VO_{2max}), yet with multiple predictors for CVD, such as elevated total cholesterol and hypertension, had lower death rates from all-causes than low-fit persons who had no other predictors.

In a rare study of the effects of physical activity on CVD incidence in older adults, Sherman and colleagues [15] examined the data from the Framingham study. In a 10-year follow-up of 75-year-old women (n=189), the more active quartiles had a greater life expectancy and were less likely to develop or die from CVD than the least active quartile. This relationship was not statistically significant for the men studied (n=96). The women in the third quartile had a death rate that was 68% lower than that in the least active group, however, it is of interest that the women in the most active quartile had a slightly elevated risk over those in the third quartile. The authors pointed out that this group had an excess of sudden

cardiac deaths that may have been caused by the interaction of vigorous exercise and occult coronary artery disease.

In a large prospective study of postmenopausal women, Kushi and colleagues [13] followed 40,417 women between the ages of 55-69 years over a seven-year period. Energy cost of physical activity was estimated from self-reported activity records. A strong and consistent inverse relationship between both all-cause and CVD mortality and physical activity was shown. This association persisted even when illness at baseline and mortality during the first three years of the study were controlled. There was also no evidence of an age and physical activity interaction, in that the protective effect of physical activity was not different for older or younger members of the study cohort. Analyses were also conducted to determine whether modest physical activity alone (without ever participating in vigorous activity) offered protection. An inverse association between frequency of moderate activity and mortality was also found, suggesting that vigorous activity is a beneficial, but not necessary, component for reducing mortality.

Two further studies have examined the degree of exercise required to impart protection against CVD mortality in women. Lemaitre and colleagues [16] described evidence that leisure time activity equivalent to walking for 40 minutes, three times a week, reduced the risk of non-fatal MI in postmenopausal women by 50%. In contrast, Folsom et al. [12] in a four to seven-year prospective study of middle-aged women (n=7853) and men (n=6188), found that vigorous sport participation was associated with reduced CVD mortality to a greater degree in both men and women than leisure-time activity such as walking and cycling.

However, in general, there is a lack of research that considers differences between men and women with respect to physical activity and CVD. Some researchers have emphasized the need for more multidisciplinary research that will better define the unique aspects of male and female cardiovascular function, and explain the basic mechanisms responsible for gender-specific differences in adaptation to physical activity [17]. Other investigators have emphasized the serious lack of research that explains the gender-specific regulation of blood pressure during physical activity, as well as the metabolic and physiologic responses to circulating sex hormones in women. These researchers argue that there is a need for research to be undertaken to describe the extent and degree of gender-specific vascular reactivity, as well to explain and confirm the mechanisms underlying these apparent differences using appropriate human and animal models [18].

2. The role of physical activity in reduction of risk factors for CVD in women

The majority of the published research linking physical inactivity and CVD explores associations between physical fitness or self-reported physical activity and CVD risk factors such as serum lipoproteins and systolic blood pressure. A few exercise intervention trials have included women, with risk factor profile generally continuing to be the outcome measured. The risk factor profiles that are examined here include serum lipids, hypertension, glucose metabolism, and obesity.

Physical activity and serum lipids

One of the major pathways by which regular physical activity is proposed to provide health benefits is through its effects on circulating lipoproteins. There is evidence that physical activity favourably influences blood lipids by increasing high-density lipoprotein cholesterol (HDL-C) levels and decreasing low-density lipoprotein cholesterol (LDL-C) and triglyceride (TG) levels [19, 20]. There is some variation in these findings between studies, which may be related to the effect of simultaneous changes in diet and body weight on blood lipids. Plasma lipid levels are tightly coupled with body weight, so a change (or decrease) in body weight has also been suggested to have favourable effects on lipid levels [21].

The blood lipid profile that is typical of women is different from that of men. Circulating estrogens in premenopausal women offers a degree of protection from CVD by virtue of their effects on sustaining high levels of serum HDL. Menopause without hormone replacement therapy is associated with a significant rise in CVD prevalence [22]. This may be more closely associated with a rise in central body adiposity and LDL-C levels than loss of HDL-C. Cross-sectional data from the Framingham study have indicated

that at the usual age of menopause, serum LDL-C rises in women to levels higher than those of men [23]. On the other hand, HDL-C levels fall only slightly in the premenopausal period and remain elevated compared to those of men. It has been suggested that the higher HDL-C levels characteristic of women does not explain all the sex differences in CVD risk [24]. Women with relatively low HDL-C levels are at greater risk than those with average and high HDL-C levels [24].

Although many studies have established the beneficial effect of exercise on lipid profiles in men, it cannot be assumed that women will benefit in the same manner [20]. There are only a few studies on the effects of physical activity on lipid metabolism in women, and even fewer have controlled for factors such as hormonal status, body composition, fat distribution, dietary intake, and smoking, all of which are known to affect lipid metabolism [19].

Lokey and Tran [20] undertook a meta-analysis of studies that examined the effects of exercise on serum lipids in women. Of the 145 studies on exercise and blood lipids that had been published to 1987, only 19% included women. The results indicated that overall, exercise training lowered triglyceride and total cholesterol, and raised HDL-C/C ratio, yet had little effect on HDL-C or LDL-C. These effects were highly related to initial levels of lipids, and were positively associated with weight loss. When comparing these data on the effects of exercise with those for men, it was evident that women respond with significantly smaller changes in lipid profiles than do men. The authors suggested that this rate contrast may be due to differences in initial levels of lipids rather than a sexual dimorphic response.

More recently, Fonong and colleagues [25] examined the relationship between HDL-C and exercise (both physical activity and physical fitness) in cohorts of older women and men. In a cross-sectional analysis in which gender data were analysed separately, neither peak VO_2 nor self-reported leisure time physical activity was significantly associated with HDL-C levels in either women or men. In the female sample, only waist circumference was significantly (negatively) associated with plasma HDL-C.

In a brief intervention trial by the same research group, in which a subsample of women and men underwent a two-month endurance training program, HDL-C levels were not significantly altered [25]. Peak VO_2 increased in these groups and energy consumption was purposefully raised in order to control for the effect of changes in either body composition or fat distribution. This study supported the results of others that suggest exercise in the absence of weight loss has little effect on HDL-C, whereas weight loss alone, especially with intra-abdominal fat loss, can raise HDL-C in women [26]. The finding that physical activity has little effect alone on cholesterol levels received recent support from Fried and colleagues [27] who examined women over the age of 65 years and reported that while physical inactivity was a predictor of all-cause mortality, neither high-density lipoprotein cholesterol nor low-density lipoprotein cholesterol were significantly associated with this relationship.

Studies of young and middle-aged women have shown more positive associations between physical activity and serum lipid profile. Owens and colleagues [28] reported on a cross-sectional study of middle-aged women who were stratified into quartiles on the basis of their self-reported physical activity (factored into weekly caloric expenditure). The data indicated that total cholesterol, TG, and LDL-C decreased as activity level rose, while HDL-C increased with activity quartile. These findings agreed with those of Eaton and colleagues [29] who noted statistically significant negative correlations between estimated VO_{2max} and total cholesterol (TC) as well as TC/HDL-C in a sample of 556 young and middle-aged women. A strong positive association between HDL-C and VO_{2max} was evident in their sample. In addition, Andersen & Haraldsdottir [30] reported that women in the lowest tertile for VO_{2max} had significantly higher TG and total cholesterol levels than women who were ranked as more fit.

In a unique study examining the associations of different exercise modalities on serum lipids, Toth and Poehlman [31] compared middle-aged women who habitually participated in resistance training with those who were endurance-trained and sedentary controls. There were no differences in HDL-C or TG among the groups. When fat mass was controlled for, significant differences among the groups for LDL-C and total cholesterol diminished. An intervention study reported by Duncan and colleagues [32] included a low-intensity walking program that was sufficient to raise VO_{2max} only minimally over a 24-week period. It

nevertheless resulted in an elevation of HDL-C in premenopausal women between the ages of 20-40 years, providing further evidence that changes in HDL-C may not be directly related to physical activity.

Physical activity and hypertension

Physical inactivity is among the primary risk factors for the development of hypertension [33]. In 1992, Arroll and Beaglehole [34] published a review of 22 research reports of investigations into the effects of physical activity on the reduction of blood pressure. While the authors suggest that the quality of much of the research is poor, they reported that in most trials, blood pressure was reduced by physical activity in both hypertensive and normotensive persons. The evidence suggested that daily activity reduced blood pressure to a greater extent than exercise performed three times per week and that the effect of exercise appeared to be independent of weight loss that often accompanies exercise training.

Many of the prospective and intervention studies discussed above also include data on the association of physical activity or physical fitness with systolic, and in some cases, diastolic blood pressure. For example, Blair and colleagues [35] followed 1219 women for up to 12 years to assess the effect of low levels of physical fitness on the development of hypertension. The risk of developing hypertension by follow-up was increased by 52% in the unfit participants when compared with those who were in the fittest sub-sample.

Eaton and colleagues [29] found significant negative correlations between estimated VO_{2max} and both systolic and diastolic blood pressure in a sample of 556 woman between the ages of 18-64. Similarly, Owens and colleagues [28] reported in their cross-sectional study of middle-aged women that both systolic and diastolic blood pressures decreased as activity level rose. In contrast, Toth and Poehlman [31] reported no differences in supine systolic blood pressure among middle-aged women who habitually participated in resistance training, those who were endurance-trained, and sedentary controls.

In a second study by Blair and colleagues [11] on all-cause and disease-specific mortality in a large prospective sample of women, the relative risk associated with the lowest level of fitness was greater than that associated with being hypertensive (defined as resting systolic blood pressures above 140 mmHg) while in the highest tertile for fitness. This suggests that a high level of fitness does not ensure normotension. However, a level of fitness does appear to reduce a woman's risk of mortality associated with high blood pressure.

Physical activity and glucose metabolism

Type 2 diabetes mellitus and hyperinsulinemia are a significant predictor of CVD in women, as in men [24, 36, 37]. Results from the prospective Nurses' Health Study suggest that women with diabetes have a six to seven-fold increased risk of CHD [38]. While the metabolic abnormalities commonly associated with this form of diabetes (such as upper body obesity, lower HDL levels, and higher TG levels) alter a woman's risk profile to one more similar to that of men, it is not known whether there is a risk associated with diabetes that is independent of these factors [24].

In a recent review of the effects of physical activity on the prevention and control of Type 2 diabetes, Ivy [39] provides an extensive analysis of the mechanisms through which exercise improves glucose tolerance and insulin sensitivity. Both acute and chronic exercise have been demonstrated to increase insulin sensitivity of skeletal muscles and other tissues, and subsequently reduce blood glucose levels in those with Type 2 diabetes [36].

In one of the few studies that have measured indicators of abnormal glucose metabolism in association with physical activity and CVD risk in women, Owens and colleagues [28] reported that fasting insulin and insulin levels two hours after a glucose load were lower among the more active women, yet neither fasting glucose nor post-load glucose showed a significant trend across quartiles of activity.

Physical activity and obesity

Excessive body fat, overweight, and/or obesity are typically listed among the risk factors for CVD. After smoking, obesity is seen as the second leading cause of preventable death in the U.S. [40]. Over the past two decades, evidence has been mounting that anatomical location of adipose tissue, specifically the presence of excess fat in the abdomen out of proportion to total body fat is an independent predictor of risk factors such as glucose intolerance, dyslipidemias and hypertension [24, 40, 41]. While central obesity, characterized by a high ratio of waist to hip girth (WHR) is more typical of males, it becomes increasingly common among females following menopause. Central obesity is an established risk factor for CVD in women as well as men [24].

Studies examining the associations of physical activity with total body fatness in women have been equivocal. Some studies, such as the Nurses' Health Study and the Iowa Women's Health Study, have shown statistically negative correlations between physical activity and Body Mass Index [9]. This is in contrast to the conclusions of Westerterp and Goran [42] who analysed body composition data from 22 different studies in which energy expenditure (and by inference, physical activity) was measured using doubly labeled water technology, the current "gold standard" for the assessment of physical activity related energy expenditure. Among the pooled subjects, a high level of physical activity was associated with a lower per cent body fat among males only. No relationship between exercise and body fatness was apparent in females. It is of interest that these 22 studies included a combined total of only 146 females (and 144 males).

This gender difference in the relationship between body composition and physical activity is consistent with the findings of others [26, 43, 44]. It has been suggested that exercise is not an effective modality for fat loss in women because they are more likely than men to compensate (by increasing dietary intake) for the increased energy expenditure associated with physical activity [42, 45]. The gender differences in body fat distribution are also likely to have a role in this dimorphism as the abdominal adiposity more typical of males has been shown to be more responsive to the hormonal environment of physical activity, in comparison to the gluteal-femoral fat characteristic of females [46, 47]. However, a number of studies have demonstrated that in women, abdominal fat depots as measured by waist to hip ratio, are highly responsive to exercise [26, 46, 48].

D. Summary

While physical activity appears to impart a degree of protection against the risk of CVD mortality in women as a result of its direct effect on cardiovascular function and role in attenuating other risk factors, the research in this area is somewhat inconclusive. Inactivity is related to all-cause mortality, especially for women, but mortality from CVD is an unusual occurrence among young and middle-aged women. Unfortunately, this is the age range followed in most of the large prospective studies. The few investigations that have included older women, (that is, those who have a high relative risk for CVD mortality), have generally indicated that regular physical activity and/or high levels of physical fitness reduce this risk. However, there have not been enough prospective studies, or those with large enough cohorts, done with women in order to identify a significant relationship between physical activity and CVD as has been established for men.

It also appears that a physically inactive lifestyle may increase the relative risk for CVD for women, although it is not clear if increased physical activity is necessary for reduced mortality. In addition, the benefits to women of different types and intensities of physical activity have not been delineated. This may be as a result of the dearth of gender-appropriate instruments for the measurement of physical activity. Blair and colleagues [10] suggested that, in light of the evidence that fitness reduces risk for CVD and all-cause mortality among women, the lack of association of self-reported activity with mortality and CHD implies that the measurement of activity may be at fault. Currently, instruments are designed with a focus on more traditional sources of physical activity for males such as sport and other leisure time activities. These miss the potentially significant sources of energy expenditure that are common among women such as childcare, household, and garden tasks.

With respect to risk factors for CVD, the associations between physical activity and dyslipidemia in women are also unclear, potentially as a result of methodological problems. Few of the studies have controlled for confounders that are known to affect lipid metabolism in women, such as hormonal status, body composition, fat distribution, weight loss, dietary intake, and smoking [19]. However, exercise does appear to be important for controlling lipid profiles in younger (premenopausal) women and exercise can potentially contribute to management of central adipose stores. It is also evident that the relationship between physical activity and serum lipids is different in women than men. Employing research models that have been constructed explicitly for studies of serum lipid relationships with CVD risk in men is likely to be inappropriate.

Hypertension and glucose intolerance are complex metabolic syndromes that appear to be linked in their association with CVD [48]. They are also powerful risk factors for CVD in women. Physical activity appears to attenuate both these abnormalities, the main effects of which may be through reduction of abdominal adiposity and by increasing insulin sensitivity. Although abdominal adiposity is a significant risk factor for CVD, especially among postmenopausal women, the risk related to general obesity, or total fatness, is inconclusive. However, exercise has been proven to be an effective fat loss modality for abdominal adiposity in both men and women, and as such should continue to be recommended for the prevention of CVD.

E. Gaps in the Literature

The benefits of being physically active appear to be achieved both independently of physical activity's effect on risk factors, and as a secondary effect of risk factors being favourably altered. Due to the widespread prevalence of sedentary lifestyles in women, enhancing physical activity in this group appears to have the potential for a substantial impact on their experiences of cardiovascular disease morbidity and mortality. However, in order for women to effectively participate in physical activity throughout their lives, additional research is needed that is centred specifically on the physiological and lifestyle aspects of girls and women.

Few studies have been designed to investigate the relationship between physical activity and CVD in women only. As a result, hypotheses and theoretical models that are either male-specific or gender-neutral drive the research questions and data collection. The lack of attention to lifestyle physical activity, such as childcare and housework, which is more common among women in comparison to men, is a good example of this. However, our understanding of the gender differences in the patho-physiological mechanisms underlying the development of CVD is increasing. As it does, we will have more gender-appropriate hypotheses from which to plan studies on the relationship between physical activity and cardiovascular health in women.

There is also a lack of long-range prospective and intervention studies designed specifically for women. This type of research could shed light on the frequency and type of activity necessary for risk reduction among women. Controlling for confounders and the covariates of physical activity and inactivity in women, such as body weight, waist to hip ratio (WHR), and hormonal changes is also important for ensuring validity of the results with respect to women, as is the use of greater numbers of research participants in order to ensure the statistical significance of any research findings.

Finally, researchers have not paid enough attention to population diversity among women in our society. More studies that include older women and women living in poverty, whose CVD morbidity and mortality risks are high, are required.

F. Implications

1. Research recommendations

Although there is a significant amount of research supporting the role of physical activity in all-cause mortality, disease prevention and improved health, the research with respect to the underlying mechanisms is inconclusive. There are insufficient data on which to draw final conclusions concerning specific recommendations for physical activity for the prevention of CVD and optimization of cardiovascular health in girls and women. In order to fully understand the benefits of physical activity in improving the cardiovascular health of women, additional research is imperative. Most importantly, prospective physical activity intervention studies targeting women at all ages are essential. Such studies should be designed to control for variations in relative intensity, total energy expenditure, physical activity modality and baseline fitness level.

Research on the relationship between physical activity and CVD would also benefit by the inclusion of multidisciplinary research. Aside from better defining the unique aspects of male and female cardiovascular function, a multidisciplinary approach could assist with understanding the interaction of physical activity with other risk factors and the mechanisms by which they occur in the development, prevention, or regression of CHD in women [8].

Studies need to be designed to consider differences in type and intensity of physical activity performed habitually by men and women. Gender appropriate measures that take into account normalized differences between social and professional status, in addition to research designs in which women and men have similar levels of daily activity, would make an important contribution in this area.

Other physiologic and metabolic differences between men and women also need further exploration. For example, there is a need for research to explain the gender-specific regulation of blood pressure during physical activity, as well as to determine the metabolic and physiologic responses to circulating sex hormones in women [18]. With respect to serum lipids, there is a need for research to determine the effect of type, duration, frequency, and chronicity of physical activity on circulating lipoprotein levels in women [8]. There is also a need for more information on the relationship between intra-abdominal fat and CHD risk in pre- and postmenopausal women, including the consideration of differences in estrogen metabolism. This area of research could be further enhanced by an evaluation of the effects of exercise and/or hormone replacement therapy on fat distribution pattern or regional obesity and its relation to CHD risk factors in pre- and postmenopausal women [8].

Finally, studies need to be more inclusive of the diversity of women in our society. There has been a serious lack of research on older women, as well as those women who are visible minorities, lower income and/or are living with a disability. This is especially true for coronary heart disease where very few studies have examined women in older age groups. Studies on older women should also include evaluation of the impact of exercise training on more basic aspects of CHD pathogenesis [8].

Physical activity has the potential to affect CHD risk, but the relationship of physical activity and training to cardiac health in women requires much more research to be done before a complete examination can be made of all the unique aspects of CHD in women.

Suggested research questions

1. How does physical activity interact with other risk factors for CVD such as smoking, obesity and age, and what are the underlying mechanisms with respect to women?
2. Are there gender-specific differences with respect to the regulation of blood pressure during physical activity? If so, how are these differences characterized with respect to vascular reactivity?
3. What is the effect of different physical activity modalities in the context of daily life on CVD and related risk factors for women? How do these compare to men?

2. Policy recommendations

Given the preponderance of research supporting the role of physical activity in all-cause mortality, disease prevention and improved overall health, women of all ages should be encouraged to increase their relative levels of participation in physical activity. This strategy is further supported by the fact that inactivity is considered to be a major modifiable risk factor for CVD with respect to prevalence, and a significant contributor to the attenuation of other risk factors. However, it is not possible at this time to claim that physical activity (or lack of) is the most potent risk factor.

It is also recommended that girls and young women include regular physical activity as a part of daily lifestyle and leisure activities in order to reduce the relative risk of CVD. As per the American College of Sports Medicine (ACSM) exercise guidelines, individuals should accumulate 30 minutes of physical activity on most, if not all, days of the week. Although the research with respect to exercise intensity is inclusive, it appears that even low levels of physical activity are beneficial.

G. Search Strategies

A comprehensive search of the medical literature published over the past 10-15 years and listed in Medline was conducted. Additional reports and published papers were identified through citations in the research literature.

The specific database years include:
- Medline 89 - 98

Specific search terms (key words) included all combinations of the following categories:
- cardiovascular disease, heart diseases, hypertension, type 2 diabetes, hyperinsulinemia
- menopause, NIDDM
- exercise, physical activity, physical fitness
- female

H. Literature Summary Tables

The following tables organize the literature reviewed with respect to cardiovascular disease and hypertension. Only those articles that investigated the relationship between physical activity and cardiovascular disease/hypertension specifically are included.

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Andersen & Haraldsdottir [30]. Coronary heart disease risk factors, physical activity, and fitness in young Danes.	• observational cohort	• women (n=115) • men (n=86) • 23-27 years of age	• VO_{2max} self-reported physical activity	• fitness (not physical activity) significantly associated with lower physiological risk factors
Blair et al. [14]. Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women.	• observational cohort	• women (n=7,080) • men (n=25,341) • 20-88 years of age at baseline • higher socioeconomic status	• physical fitness: maximal treadmill test	• fitness associated with reduced all-cause mortality (including CVD); even in presence of other risk factors

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Blair et al. [10]. Physical activity, physical fitness, and all-cause mortality in women: do women need to be active?	• prospective cohort • mean: 8.2-year follow-up	• women (n=3,120) • men (n=10,224) • higher socioeconomic status • healthy at baseline	• physical fitness: maximal treadmill test • self-reported physical activity	• strong association between fitness and all-cause mortality in men and women • no relation between activity and mortality in women
Eaton et al. [29]. Physical activity, physical fitness and coronary heart disease risk factors.	• observational cohort	• women (n=556) • men (n=382) • 18-64 years of age	• measure of physical fitness (step test) • self-reported physical activity	• physical fitness significantly cor-related with HDL, TC/HDL • significant inverse correlation with blood pressure, BMI and smoking
Folsom et al. [12]. Physical activity and incidence of coronary heart disease in middle-aged women and men.	• prospective (4-7-year follow-up)	• non-blacks and blacks • women (n=7853) • men (n=6188) • 45-64 years of age.	• self-reported physical activity at baseline	• sport and leisure physical activity associated with reduced CHD incidence and total mortality
Fonong et al. [25]. Relationship between physical activity and HDL-cholesterol in healthy older men and women: a cross-sectional and exercise intervention study.	• cross-sectional • intervention	• women (n=138) • men (n=169) • 55-90 years of age. • women (n=14) • men (n=23)	• self-reported leisure time activity • two months endurance training • peak VO_2 measured	• no correlation between HDL-C and physical activity in women • significant association in men • no gender differences • pooled data showed no increase in HDL-C
Kushi et al. [13]. Physical activity and mortality in postmenopausal women.	• prospective	• women (n=40,417) • 55-69 years of age at baseline	• self-reported physical activity	• higher levels of physical activity were associated with reduced risk of CVD and all-cause mortality
Lokey & Tran [20]. Effects of exercise training on serum lipid and lipoprotein concentration in women: a meta-analysis.	• meta-analysis of 27 exercise intervention studies.	• women (n=460) • 20-56 years of age	• aerobic exercise training	• significant reduction in TC, TG, TC/HDL-C
Owens et al. [28]. Physical activity and cardiovascular risk: a cross-sectional study of middle-aged premenopausal women.	• cross-sectional	• healthy pre-menopausal women (n=533) • 42-50 years of age.	• self-reported physical activity to estimate weekly energy expenditure	• higher energy output associated with lower fasting insulin, insulin response, TG, TC, LDL, skinfolds, resting HR, BMI, blood pressure; and higher HDL
Sherman et al. [15]. Does exercise reduce mortality rates in the elderly? Experience from the Framingham Heart Study.	• prospective	• women (n=189) • men (n=96) • 75 years of age and older	• self-reported physical activity at baseline	• lower 10-year, and 16-year CVD morbidity and mortality, and all-cause mortality associated with higher quartiles of physical activity

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Toth & Poehlman [31]. Resting metabolic rate and cardiovascular disease risk in resistance- and aerobic-trained middle-aged women.	• cross-sectional	• resistance-trained, endurance-trained and untrained women (n=54) • 36-53 years of age	• previously resistance-trained, endurance-trained, and untrained • peak VO_2 • self-reported leisure time physical activity	• between-group differences in serum LDL-C and total C were related to differences in fat mass • no differences observed in HDL or TG

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VI. OSTEOPOROSIS PREVENTION

Moira A. Petit, M.Sc., Heather A. McKay, Ph.D., Karim M. Khan MD, Ph.D.

A. Chapter Overview

What do we know?

Maximizing peak bone mass during the growing years may be an effective means of preventing osteoporosis in later life. Evidence from laboratory, epidemiological, and field-based exercise studies show a critical role for physical activity in the attainment of peak bone mineral density during the growing years, for the maintenance of bone during the premenopausal years, and for slowing bone loss during the postmenopausal years.

What do we need to research?

There continues to be selection bias in many of the studies that have established a relationship between bone density and physical activity. There are still very few randomized intervention trials and most studies inadequately control for hormonal status (both pubertal and menopausal), nutrition, and genetics.

There is also a need for studies involving ethnic groups other than Caucasians, with special attention given to Asians due to the rising incidence in the prevalence of hip fractures in this group and the increasing number of Asian residents in Canada.

What should we do?

Osteoporosis prevention strategies need to be aimed at an entire population as the risk for fracture is increasing dramatically, and physical activity is a practical and potentially low-cost strategy for population-based prevention. However, it is important to consider the role of different exercise prescriptions for cardiovascular endurance and muscular strength and hormonal status and stage of life, which greatly influences the bone response to exercise and loading. The following are more specific recommendations for practice and policy:

- A lifetime of physical activity should include high-impact, weight-bearing activities of varied or diverse movements.
- Exercise programs should be started at an early age and maintained into adulthood, and targeting elementary school children is warranted so that bone healthy activities can be included from an early age.
- Women should have reasonable access to activity programs.
- Immobilization should be avoided at all costs (i.e., bed-rest).
- Older women should add a routine exercise aimed at increasing muscular strength and balance to assist in the prevention of falls.
- A healthy diet of adequate calcium, vitamin D, and total energy intake, in addition to physical activity, is positive for bone health.

B. Introduction

Age-related fracture represents an increasing health care problem that may reach crisis proportions based on current demographic trends [1, 2]. The number of fractures, their associated costs, and the resultant trauma on the lives of those affected, will increase dramatically in the next few decades. Clearly, something must be done in the present to reduce the number and risk of fractures, and avoid this future health care crisis.

At conception we are provided with a genetic template for the skeleton that is modified throughout life by the way that we eat and the way that we move, by the forces of gravity, loading and muscle contraction, as well as by a host of other internal and external influences. The skeleton has an enormous capacity to adapt to the demands and insults of everyday life.

Our understanding of the skeleton has undergone a transformation in the last decade. Old ideas of the skeleton as a static support structure have given way to a more appropriate acceptance of the dynamic nature of bone tissue and its contribution to overall health and well-being. The term "osteoporosis" was first coined in the French medical literature in the early 1820s as a simple description of the pathological state of bone and did not find its way into the English medical vocabulary until the 20th century [3]. The definition of osteoporosis has evolved to reflect our increasing knowledge of this condition. At the 1994 World Health Organization Osteoporosis Consensus Development Conference, osteoporosis was defined as

> a disease characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility which leads to a consequent increase in fracture risk [4].

The risk factors for osteoporosis (Figure 1) encompass both non-modifiable factors such as age, sex and race, as well as modifiable lifestyle factors such as physical activity, body composition and dietary intake (especially calcium). If it were possible to optimize peak bone mass, conserve bone throughout adult life and to slow the rate of loss as we grow older, osteoporosis might be a largely preventable disease.

Figure 1. Risk factors for osteoporosis

- Sex - female
- Advancing age
- Ethnicity - especially Asian or Caucasian
- Family history of osteoporosis or fracture
- High doses of glucocorticoids or other bone resorbing agents
- Endocrine disorders
- Amenorrhea due to menopause (surgical or natural), or hypothalamic amenorrhea[1]
- Anorexia nervosa
- Inactivity / non-weight bearing exercise
- Bed-rest with no weight-bearing
- Low muscle mass
- Low calcium or vitamin D intake
- High alcohol and/or caffeine consumption

Prevention and treatment of osteoporosis is one area of health research that has focused on women largely because of the rapid bone loss and increased fracture risk associated with menopause. Although men are increasingly among those with osteoporosis, Caucasian women are still nearly three times more likely to suffer a hip fracture at some point in their lifetime [5]. After 50 years of age, the risk of fracture is twice as great in women as in men. As there are also more elderly women than men, 80% of all hip fractures occur in women [5]. The lifetime risk of fracture at any site (hip, spine, distal forearm) is 40% for women and 13% for men after age 50 [5]. Asian-Canadian women comprise an increasing proportion of Canadians and are among those at high risk for hip and spine fractures [6]. There is, however, less research directed toward minority groups living in Canada. Projections suggest that one in three women in North America will suffer an osteoporotic fracture by age 65, and age-adjusted hip fracture rates are expected to increase dramatically over the next decade [7].

Most commonly, osteoporosis "prevention" has been aimed at slowing bone loss associated with menopause through hormone replacement in postmenopausal women. However, low bone density associated with osteoporosis is a function not only of age-associated bone loss, but also the proportion of the genetically predetermined peak bone mass attained during the growing years. Osteoporosis, therefore, may begin early in life when optimal bone mineral accretion is critical to the attainment of a healthy adult skeleton. Mechanical loading of bone through physical activity and sport-specific exercise is

[1] The exception is women with amenorrhea due to androgen excess who are not necessarily at risk for low bone density and are likely to have normal or high bone density.

a promising means through which children and adolescents can optimize bone mineral accrual, and as a strategy for adults and postmenopausal women to maintain bone mass and/or slow bone loss.

Evidence for a beneficial effect of physical activity comes from epidemiological, laboratory and exercise studies. Epidemiological studies of large populations show that women and men who are most physically active have either higher bone mineral density (BMD) or a lower risk of fracture [8-10]. These data are supported by animal studies that show bone increases in density and/or changes in architecture in response to site-specific loads, thus becoming a stronger structure and more resistant to fracture. The type of exercise that is most osteogenic (bone forming) is high in magnitude and unusual in distribution [11, 12] such as gymnastics, jumping or rope skipping. It is also clear from animal data that growing bone responds to loading more favourably than mature bone [13].

While the epidemiological and biological evidence clearly show physical activity is beneficial to bone, exercise studies in girls and women are somewhat equivocal. The bone response to exercise interacts with the genetic, nutritional and hormonal environment. The rapidly changing hormonal milieu in girls as they approach puberty and in women approaching menopause, creates additional challenges for researchers attempting to identify strategies to maximize bone mass.

The aim of this review is to examine the association between physical activity and skeletal health across the life span. We evaluate and summarize the exercise and bone density literature at three key periods: during childhood and adolescence, during adult life (pre- and perimenopause) and in later life (postmenopause). The role of exercise in the prevention of falls is also briefly discussed.

1. Terminology

Prior to discussing the results of this review, it is important to clarify terminology. We will briefly discuss three key areas related to bone and exercise studies:

- the terms utilized when describing the maturation/hormonal status of women participants
- terminology and methods of measuring bone mass
- definitions of general physical activity versus specific mechanical loading as they relate to, and influence, bone

Maturation/hormonal status

- Prepubertal girls have no sign of development of secondary sex characteristics (Tanner stage 1).[2]
- Early puberty is rarely identified in the literature. It is the early stages of sexual maturation (Tanner stage 2 and/or 3). For girls, this is assessed by the beginning of breast development.
- Late-puberty Tanner stage 4 or 5 for breast and pubic hair development.
- Postpubertal girls are in the final stages of breast and pubic hair development (Tanner stage 5) and have reached menarche (their first menstrual period).
- Premenopausal women have established regular, ovulatory, menstrual cycles. Typically, women experiencing monthly flow and between the ages of 20-45 years were classified as premenopausal in the reviewed studies.
- The perimenopause is considered to be the years (generally 2-8 years) prior to menopause when hot flushes and vasomotor symptoms begin, but flow is still occurring (although it may be irregular), and the first year after cessation of flow. To date, defining the perimenopause is typically done retrospectively or assumed to occur at about the same age in all women. Women in the only exercise intervention study of “perimenopausal” women were recruited based on age, rather than hormonal status.
- Menopause is defined as the cessation of menstrual flow. In studies reviewed women were classified as postmenopausal if flow has ceased for at least six or 12 months. Women experiencing amenorrhea (cessation of menstrual flow) for other reasons (i.e., pregnancy or hypothalamic amenorrhea) are not included in this definition.

[2] For growing girls maturational status is commonly rated from 1 (least mature) to 5 (most mature) using Tanner stages of pubic hair (PH) and breast (B) development.

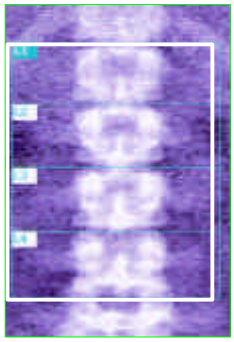
Measurement of bone mass

The ultimate goal of osteoporosis research is to decrease fracture risk. As weaker bone is more likely to fracture, this review asks "to what extent can exercise or physical activity increase bone strength?" The capacity of bone to weight-bear is based on its intrinsic material properties, the amount of bone present (mass) and the internal architecture or shape of the bone. Current technology allows us to measure bone mineral content in humans as a surrogate for bone mass and thus provides some representation of bone strength. However, because the amount of mineral in bone is dependent on the size of the bone, we attempt to account for differences in size and for growth by expressing bone mineral content (g) per unit area (cm^2) of bone or as bone mineral areal density (BMD, g/cm^2). BMD is most commonly measured by dual-energy X-ray absorptiometry (DXA) or other absorptiometric techniques. Volumetric bone mineral density, however, implies measurement of the amount of mineral per volume (g/cm^3) of bone mineral. DXA is therefore limited by its two-dimensional representation of the three-dimensional spatial properties of bone. This makes DXA a poor choice for studies that involve growing children, unless growth is otherwise accounted for, and for studies that compare individuals of different sizes, unless size differences are accounted for. Despite this limitation, DXA remains a precise and accurate tool for the assessment of bone mineral in vivo and it is widely used in clinical practice for the diagnosis of osteoporosis. Further, the relationship between BMD and the risk of osteoporotic fracture is well established [14]. It is important to remember, however, that although women with low BMD are more likely to fracture, BMD is only one of the many determinants of fracture risk [5].

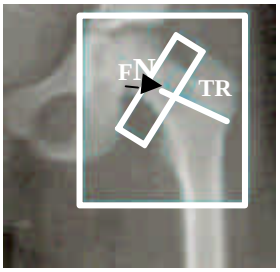
Due to the predilection of osteoporotic fracture for skeletal sites containing a high proportion of trabecular bone, the proximal femur (hip) and spine are the most commonly measured clinical sites. Figure 2 shows the lumbar spine (L1-L4) and proximal femur and its regions (trochanter and femoral neck) that are most commonly measured and reported in exercise studies.

Figure 2. Commonly measured bone regions in determining risk for osteoporosis include the a) lumbar spine (L1-L4) and b) the proximal femur (PF) including its femoral neck (FN) and trochanteric (TR) regions.

a) Lumbar Spine



b) Proximal Femur



Physical activity vs. mechanical loading

Studies examined either "general physical activity" or "mechanical loading" as they relate to bone density. General physical activity was typically assessed by questionnaire and reported as a total score of all daily activities. It included activities such as walking, gardening and sports. Activities that put strain on a specific bone, or bones, are considered examples of mechanical loading. Running, for example, places a mechanical load specifically on the lower limbs while tennis loads the forearm. Gardening, however, would not be considered an example of specific mechanical loading, but would be included in general physical activity [15]. These distinctions are important as exercise has site-specific effects on bone. That is, just as muscle strength is increased primarily for those muscles utilized in a given exercise, bone

strength (as measured by its density in this case) is increased at the sites loaded. For example, running or jumping would be expected to affect bone strength at the hip, while tennis or upper body weight lifting would more likely affect bone strength of the radius. General physical activity may or may not influence BMD, and any significant relationships between activity and BMD will depend on the type of activity (or activities) performed, as well as the bone site that is measured.

C. Literature Review

The studies in this review are organized and discussed in two ways. Firstly, they are organized by the age at which physical activity or mechanical loading was measured, or at which intervention took place. Secondly, they are organized according to whether general physical activity or sport-specific loading were assessed. Study designs that utilized an exercise intervention are emphasized and summarized in tables at the end of this chapter. The literature categories include: childhood and adolescence; premenopause; perimenopause; and postmenopause. The final section briefly reviews literature on the role of physical activity in the prevention of falls.

1. Studies of children and adolescents

It has been suggested that the ability of bone to adapt to mechanical loading is much greater in the immature, as compared with the mature, skeleton [13]. Osteoporosis prevention, therefore, may begin early in life when optimal bone mineral accretion is critical to the attainment of a healthy adult skeleton [16-18]. Peak bone mass is a major determinant of adult bone mass which is, in turn, related to fracture risk [19]. Upwards of 90% of adult bone mass is achieved by the end of adolescence and subsequent gains are relatively small [20-23]. The biggest gains occur during adolescence, and for this reason there is increasing interest in normal growth and mineralization of the skeleton, especially during puberty when maximum accrual velocities are observed [24]. Although peak bone mass is largely determined by genetics, which accounts for over half of the variance [25], modifiable lifestyle factors, including physical activity, play an important role.

General physical activity

The association between bone mineral density (BMD) and general physical activity in childhood has been examined using several study designs including: comparisons of dominant and non-dominant limbs; relating current physical activity to BMD at the spine and femur; and by retrospective analysis of childhood physical activity as it relates to adult BMD. Two recent reviews of the relevant literature suggest a generally beneficial effect of physical activity during childhood and adolescence on BMD [26, 27]. Normally active children had 3-6% greater bone mineral content or density in their dominant versus non-dominant limbs [28, 29]; children who were more physically active had higher hip and/or spine BMD in cross-sectional studies [30-32]; and adults who were the most active during childhood had higher BMD compared with their less active counterparts in most retrospective reports (Table 1) [33-36].

A few studies report no effect of childhood physical activity on BMD. Boot and colleagues [37] found that physical activity was related to lumbar spine BMD in boys, but not in girls, aged 4-20 years. One prospective study looked at BMD change over three years in pre-, peri- and postpubescent twin pairs. Self-reported physical activity was related to femoral neck BMD in pre- (mean age 7.4 years) but not peri- or postpubescent children [22].

Only one North American study has included children and adolescents of Asian descent. In a study of bone mineral in Asian and Caucasian males and females aged 9-26 years, there was no relationship between everyday physical activity and BMD at any site [38].

Mechanical loading studies

Cross-sectional studies of young athletes assessed during childhood also suggest that activity is beneficial to bone. Bone mineral density at loaded sites is consistently higher in athletes than normally

active controls. Consistent with biological theory [12, 39], athletes in sports that induce the highest and most unusual loads also have the highest BMD at loaded sites. For example, gymnasts have higher femoral neck and spine BMD than swimmers or controls [40-42], and young figure skaters have higher BMD than controls in their lower body, but not at upper body sites [43]. Swimmers and cyclists tend to have BMD similar to controls and lower than athletes in weight-bearing sports despite high loads from muscular activity [41]. Overall, in cross-sectional reports, early or late pubescent gymnasts had 7-20% greater BMD than age-matched controls [40-42]. Prepubertal gymnasts also had 12-16% higher BMD than controls, and had a substantially greater increase in BMD than controls when followed for one year (Table 2) [40, 44]. It should be noted that there is a limitation of studies of athletes in differentiating between the potential genetic predisposition of elite sports participants to high bone mineral density, and the influence on bone mineral of the loads induced by the sport itself.

A few retrospective studies, in which exercise undertaken in childhood was related to adult bone status, show that sport participation during childhood predicted adult BMD (Table 1) [40, 45-47]. In 99 retired ballet dancers (mean age 51 years), weekly hours of ballet performed between the ages of 10-12 years was related to femoral neck BMD, while current physical activity and years of full-time ballet were not [45]. Adult BMD at weight-bearing sites is also higher in retired gymnasts (who began training before menarche) than normally active controls [40, 46, 47]. Bass and colleagues show the 6-16% greater BMD was consistent in gymnasts regardless of the number of years since retirement. Both the retired gymnasts [40] and ballet dancers [45] maintained the benefit of childhood/adolescent training even with cessation of training for several years. Kontulainen [48] drew similar conclusions in a study of detraining in tennis players.

A distinguished group of researchers from the UKK Bone Research Institute in Tampere, Finland has reported side-side bone mineral differences in squash and tennis players to examine if there is an optimal age during which exercise can effect bone. In a study of 105 elite women squash and tennis players, they report a beneficial effect of mechanical loading on bone when exercise is introduced prior to puberty. As a group, bone mineral content (BMC) was 13% greater in the loaded (preferred) versus the non-loaded arm. Athletes were then split according to when training began. Loaded versus non-loaded arm differences in BMC were 17-24% in those women who began training before menarche, and 8-14% different in those who began training after menarche [29]. A recent cross-sectional study of 7-17-year-old tennis players was conducted by the Finnish group to see at what maturity level these loaded-versus-non-loaded side differences became evident [49]. The authors identified side-side differences once girls reached the adolescent growth spurt (Tanner stage III). These data suggest a specific exercise effect that is dependent on, and closely linked to, maturational status.

Exercise intervention

Only one intervention study in prepubertal girls has been published to date. Morris and colleagues [50] monitored change in bone density over 10 months (January to October) in girls aged 9-10. Thirty-eight girls participated in an intervention program and 33 age-matched girls served as controls. Girls in the intervention group participated in a variety of activities for 30 minutes three times per week over eight months (February to September). The activities included “high-impact” aerobics, soccer, Australian football, step aerobics, bush dance, skipping, ball games, modern dance, and weight-training. When changes in height and weight were controlled for, girls in the intervention group had significantly greater increases in whole body BMD (+2.3%), lumbar spine BMD (+3.6%) and proximal femur (+3.2%) BMD [50]. However, this study has been criticized for possible discrepancies in maturation between exercise and control groups. As suggested by the non-significant increase in volumetric BMD:

> mismatching by bone age and growth velocity of the region appears to be a more likely explanation of the two to eight fold more rapid increases in bone size than exercise [51].

A recent randomized intervention trial at the University of British Columbia, Vancouver, was directed towards establishing the effects of a physical-education-based exercise intervention program on the skeletons of pre-pubescent Asian- and Caucasian-Canadian children. Early findings suggest a

significantly lower general physical activity level and dietary calcium intake in the Asian children [52] and a small benefit at the trochanteric region of the femur for the exercising group [53].

Summary

There are now a number of cross-sectional and retrospective studies that show both general physical activity and sports participation in childhood and adolescence are related to higher bone mineral density (BMD) during the years of growth. However, these studies are limited in their generalizability. Factors other than physical activity also have a strong influence on BMD. For example, genetic and nutritional influences are likely to be different in athletes than normally active individuals, and interact with exercise to positively affect BMD [54-56]. Furthermore, the observational studies that relate BMD or change in BMD to physical activity in children and adolescents may be confounded by pubertal status. That is, children of the same chronological age can vary significantly in their maturational status. Children at the same maturity level at the start of an intervention trial may also develop at different rates during the course of the study. This may result in changes in bone mineral as a function of growth inappropriately being attributed to exercise. To date, only small numbers of pre- and peri-pubertal girls have been included in the observational studies.

The studies that compare dominant and non-dominant limbs provide a controlled model for examining the role of loading on bone. Both limbs share the same nutritional, genetic, and hormonal environment, thus any difference in bone mineral can be attributed to loading. These studies [29, 57] and other retrospective studies show a beneficial effect of childhood activity on adult BMD [45]. These studies also support animal data which demonstrates that young bone is more responsive to mechanical loading than mature bone [13]. It also appears that exercise started prior to puberty is more beneficial to bone than exercise begun during or after puberty [29, 45]. There may be a brief and unique period during the growing years when bone is most responsive to exercise [58]. To determine if, and when, this opportunity exists, studies need to include larger samples of girls in each pubertal group, and they need to be performed as longitudinal, randomized intervention studies.

The one intervention study in prepubescent girls appears to support the notion that young bone is highly responsive to loading [50]. The 2-3.5% greater increase in BMD of exercisers compared to controls after eight months of intervention is greater than that seen in one-year intervention studies of pre- or post-menopausal women. However, in addition to the short duration of the study, the results are limited in their generalizability because the groups were not randomized. Girls in the intervention group participated in 30 minutes of activity three times per week. Although dropout rates were low, this might be explained by participants who were self-selected and thus more highly motivated to complete the intervention. As an after school program that places increased time demands on children may limit participation, a program designed for physical education classes might reach a larger population. Finally, without longitudinal follow-up, the long-term benefit of the intervention is unknown. It is possible that BMD in the controls will “catch-up” once intervention ceases, or at some point over the growth process, as has been shown to occur with cessation of calcium intervention in this age group [59-61]. The long-term (adult) benefits of childhood intervention has yet to be adequately studied.

2. Premenopausal women

It is generally accepted that BMD remains relatively stable once peak bone mass has been attained through to menopause. However, a few studies have shown spinal cancellous bone loss of 1-3% per year in healthy premenopausal women [62, 63]. Studies that examined changes in bone related to lifestyle factors are somewhat limited in this age group. Of those studies, the majority of participants are Caucasian women with only a few studies of Asian women [64, 65]. Exercise intervention studies are limited to Caucasian women only. The need for research directed toward the Asian population is demonstrated by the drastic increase in age-specific fracture incidence in Asia and countries that are becoming rapidly industrialized. As early as 1970, Chalmers and Ho [66] suggested the incidence of fracture was related to sedentary lifestyles in Western societies and predicted the increase in fracture incidence that has, subsequently, occurred with urbanization in much of Asia [6, 67]. These data suggest an important role for physical activity in maintaining peak bone mass during the adult years.

General physical activity

Of the observational studies of Caucasian women, approximately half show a positive correlation between general physical activity and lumbar spine or femoral neck BMD [56, 68, 69, 70] while others show no relationship [71-73] (Table 3). One prospective report showed a significant effect of physical activity and change in spine BMD over four years in 156 college-age women [74]. The few studies in Asian women suggest a positive association between physical activity and BMD in Asian women living in China [64, 65].

Mechanical loading in athletes

Cross-sectional studies comparing BMD in mature premenopausal athletes and controls have recently been reviewed by several authors [13, 75, 76]. Consistent with the data in children and adolescents, collegiate athletes typically have higher BMD at loaded sites than their sedentary counterparts [77, 78]. High loading sports such as gymnastics and ballet are also apparently more osteogenic than running [77, 79] or non-weight bearing activities (swimming or cycling). When athletes with consistent menstrual cycles are compared with consistently menstruating controls, bone density at loaded sites is an average of ~10% higher in athletes [13, 75, 76].

Exercise interventions

Exercise intervention studies in adult women show BMD maintenance after one year [80, 81], or slight gains of 2-3% after two years [82] of weight lifting intervention (Table 4). The greatest change in BMD was seen from a 6-10 minute per day jumping intervention in 14 women (mean age 32 years) in which hip BMD increased 3-4% over six months [83]. In a slightly older group of premenopausal women (mean age 39 years) high-impact jumping over 18 months for 20 minutes three times per week significantly increased femoral neck and spine BMD by 1.6-1.8% as compared to 0.6% change in controls ($p = 0.0006$) [84]. In all studies, the mean BMD of the control group did not change significantly.

The studies showing no effect of physical activity generally utilized programs of lower impact exercises [85, 86]. One study reports a significant decrease in spine BMD after nine months of resistance training with no change in the controls [87]. This study has been criticized for the small sample size (10 exercisers, seven controls) and lack of randomization [15, 88]. Participants were able to choose their study group and as a result four of the women in the exercise group were regular exercisers prior to entry into the study while all of the controls were sedentary. If the intervention consisted of less activity than subjects typically completed, the decrease in spinal BMD in the exercisers could be attributed to a “detraining” effect.

Summary

With respect to premenopausal women in general, the premenopause appears to be more a time of bone mineral “conservation” than bone mineral accrual. Once peak bone mass is reached, only small increases in BMD occur even when women undertake high intensity activities. Intervention programs that showed small increases of 1-2% in hip BMD involved higher impact jumping exercises [82-84] or high intensity strength training [89]. In contrast, a longer duration (three years) exercise intervention that increased muscle mass, but was lower intensity, did not increase BMD [90]. In North America, drop-out rates among premenopausal and postmenopausal women are consistently over 50% in the second six months of longer intervention studies [82, 89]. This is despite an initially high motivation level of women choosing to participate in intervention studies and close supervision by fitness trainers. This suggests that the usefulness of such programs for a majority of women may be questionable. Women of low socioeconomic status, for example, are unlikely to have easy access to strength-training equipment and personalized fitness trainers.

The jumping program of Bassey and colleagues [83], where participants completed activities unsupervised at home, may be more practical for population-based intervention strategies. Although total exercise time was 60 minutes, the jumping activities which were the primary osteogenic component of the program, took less than 10 minutes to complete. A 10-minute jumping program that could be done at home would be feasible for a majority of the population.

3. Perimenopause

Although the perimenopause is traditionally viewed as a period of rapidly decreasing estrogen levels associated with menopause, bone loss is thought to occur only in postmenopause. In reality, a woman's hormonal environment and related symptoms are distinctly different between the peri- and post-menopausal years. A detailed review of the perimenopause challenges traditional views and demonstrates that estrogen levels are higher than average and often erratic during the perimenopause [91]. These erratic changes in hormone levels could initiate rapid bone loss during the years prior to the postmenopause. Research on women in the perimenopause is practically non-existent. This group is either neglected completely or combined with menopausal women, largely due to lack of clear defining criteria. From limited data available, the perimenopause can be a time of rapid bone loss [91] and may be an optimal time for intervention.

Only one study has specifically identified women as perimenopausal and examined exercise effects on BMD. Women were selected based on age rather than documentation of hormonal status. A group of previously sedentary women aged 52-53 was assigned to 18 months of either calisthenics, endurance, or control groups. Endurance exercise was undertaken four times per week at 55-75% of max VO_2 [92]. The endurance training group tended to maintain BMD at the femoral neck while the control group lost bone. This difference was significant ($p = 0.04$). There was no apparent effect of the calisthenics program at any other site (femur, lumbar spine, calcaneus or distal radius) [92].

4. Postmenopausal women

Bone loss at the menopause is closely linked to the decreased ovarian function and lower levels of estrogen and progesterone. Hormone-dependent bone resorption increases the accelerated rate of bone loss during the first 5 or 10 premenopausal years and is thought to be the primary contributor to the development of osteoporosis [93, 94]. There is, however, tremendous variability in rates of bone loss. Exercise intervention studies aimed at increasing BMD or slowing loss have largely targeted postmenopausal women and there is now a large body of literature in this age group.

In a recent meta-analysis of 18 intervention studies in postmenopausal women, Berard and colleagues [95] reported no overall effect of exercise intervention on BMD at the hip or spine. However, when only those studies from 1991 and later were included, there was a significant effect of exercise at the spine, but not the hip [95]. The authors suggest the exercise in more recent studies included higher loads than earlier studies. This supports studies that show a higher intensity of walking exercise is necessary for a beneficial effect on BMD in postmenopausal women. Hatori and colleagues [96] reported an increase in lumbar BMD with very fast (7.2 km/h) walking (performed at cardiovascular workloads greater than the anaerobic threshold), and no effect on BMD with slower walking (6.2 km/h -below anaerobic threshold) [96]. Martin and Notelovitz [97] also observed that walking at less than 6.4 km/h did not increase lumbar BMD.

Despite the careful meta-analysis, Berard and colleagues [95] failed to separate those studies that specifically placed high loads on the hip or spine and measured BMD at those sites. Several studies do show a benefit of exercise on hip or spine BMD when those sites are targeted (Tables 4 and 5). Studies where higher impact exercises targeted the spine showed a 1-5% increase in spinal BMD (Table 4) and studies of high impact at the femoral neck demonstrated a 0-3.5% increase (Table 5). A loss of BMD was consistently demonstrated in sedentary or normally active controls. Exercise programs that were primarily aerobic in nature, such as low-impact aerobics, walking, or jogging, prevented bone loss in most cases. The benefit of exercise appears to be lost when training stops in this age group [98], although more follow-up studies are required to adequately support this contention.

Summary

Bone loss during the postmenopausal years is inevitable. The role of exercise during this phase of life appears to be to either stay or diminish the rate of loss. Despite the large body of literature in the area, the optimal intervention program for impacting bone in postmenopausal women is still somewhat unclear. The jumping intervention that showed an increase in femoral neck BMD in premenopausal women was ineffective in increasing BMD in postmenopausal women [83, 99]. Generally, both aerobic and strength programs show only small increases, or decreased loss, in hip or spine BMD in postmenopausal women. Overall, exercise intervention effectively decreases bone loss in postmenopausal women, but gains in BMD have not been shown to occur. The main role of exercise in postmenopausal women may be to increase functional mobility and decrease risk of falling.

5. Physical activity and prevention of falls

In addition to positively affecting BMD, physical activity decreases fracture risk by improving balance, muscular strength and coordination, all of which are risk factors for falls. Physical activity is generally associated with a decreased risk of falling in observational studies [100-102]. There is limited direct evidence showing a decrease in falls with exercise intervention [103], but several studies show an improvement in risk factors including muscular strength and balance. Strength training led to a 5-200% increase in muscular strength in studies that intervened for three to six months in older adults [104, 105]. Increases in strength did not necessarily improve balance, but exercises aimed specifically at improving balance helped prevent falls [106]. A meta-analysis of the FICST (US Frailty and Injuries Cooperative Studies of Intervention Techniques) trials, which followed 2300 women over age 65 for two to four years, showed that adding balance exercises decreased the risk of falling by an additional 17% over exercise alone [106]. Wolf and colleagues [107] showed that Tai Chi exercise improved balance and nearly halved the risk of multiple falls. Most physical activity studies in older adults have targeted individuals younger than 75 years of age, but a recent report shows improvement in muscular strength, gait velocity, and general physical activity even in a population with a mean age of 87 years [108].

D. Summary

Hormone replacement therapy prescribed for the postmenopausal woman has been the popular prescription for osteoporosis “prevention”. There are now sufficient data to show that maximizing peak bone mass during the growing years may be an effective means of preventing osteoporosis in later life. Evidence from epidemiological, laboratory and field-based exercise studies show a critical role for physical activity in the attainment of peak bone mineral density during the growing years, for the maintenance of bone during the premenopausal years, and for slowing bone loss during the postmenopausal years. Osteoporosis prevention strategies need to be aimed at an entire population as the risk for fracture is increasing dramatically. Physical activity is a practical and potentially low-cost strategy for population-based prevention. However, the task is more complex then simply prescribing “physical activity”. Just as different exercise prescriptions are given for cardiovascular endurance and muscular strength, bone also responds to specific exercises. As well, hormonal status and stage of life greatly influence the bone response to exercise/loading.

E. Gaps in the Literature

It is clear that a lifetime of physical activity which utilizes large muscle groups and loads specific parts of the body (the hip and spine) is critical for bone health. There are now a plethora of cross-sectional studies showing a relationship between general physical activity and BMD, and showing significantly higher BMD at loaded sites in athletes versus controls. The athlete studies by their nature, however, introduce selection bias and should be interpreted with that in mind. There are still very few randomized intervention trials and most studies inadequately control for hormonal status (both pubertal and menopausal), nutrition and genetics. The “ideal” exercise intervention has yet to be identified. There is also a need for studies

involving ethnic groups other than Caucasians, with special attention being given to Asians due to the rising incidence in the prevalence of hip fractures in this group [6] and the increasing numbers of Asian residents in Canada. The specific gaps in the literature that have been identified in this review include: the lack of randomized prospective intervention trials; the lack of follow-up studies; the consideration of age-specific exercise programs; the lack of inclusion of ethnic diversity; lack of control for interactions; and the lack of consideration of clinical populations.

1. Randomized prospective intervention trials

Randomized exercise intervention studies are lacking in all age groups. There is only one published intervention study (non-randomized) in prepubescent girls, and a recently published randomized intervention trial at the University of British Columbia. These reports require substantiation by other randomized studies and should be repeated within other multiethnic populations. Longitudinal exercise intervention trials that follow girls through puberty are also required to determine the optimal age of intervention. Intervention studies that target perimenopausal women are essentially absent from the literature. It is important that this absence be addressed. Further, the perimenopause needs to be adequately defined and hormonal status controlled in studies undertaken during this phase of life.

2. Follow-up

It appears that the benefits of exercise during adulthood on bone are lost during detraining [48]. Although retrospective studies of retired elite athletes suggest the benefits of childhood exercise persist into adult life, it is not clear if this is also true for less intensive physical activity undertaken in childhood. Follow-up studies are needed to examine the prolonged benefits, if any, of activity undertaken during childhood/adolescence.

3. Age-specific exercise programs

If exercise is to increase bone mass it needs to satisfy two criteria. Firstly, activities must be intense enough to induce an osteogenic response. Secondly, activities must be accessible and enjoyable enough so that the majority of the population can, and will, partake of them. Specific activities that are most osteogenic have yet to be clearly defined in humans. Preliminary data show that rope skipping and jumping activities induce the highest ground reaction forces, which should translate into high strains on bone. There is a need to define the loads imposed by different kinds of activities in all age groups and to develop age-specific intervention programs. It is clear that high, and unusual, loading activity increases bone mass. This is illustrated in studies of elite gymnasts who consistently have higher BMD in the arms, spine and femur than girls and women in any other sport. Clearly though, only a very small proportion of the population can partake in such high intensity activities. The task, then, is to design intervention programs that are easily implemented within a community-based setting and in which a large proportion of the population can, and will, participate.

The jumping programs of Bassey and colleagues [109], that effectively increased BMD at the hip in premenopausal women, required only a small time commitment from women and could be completed in the home without supervision. These types of programs, if proven effective, would be practical for population-based interventions.

There is also a need for studies that test longer interventions. Current studies are, at most, one or two years in length. Bone remodeling cycles occur over 6-12 months. Therefore, prospective interventions of several years are necessary to determine the long-term effect of various activities on bone and the response of bone to cessation of intervention.

4. Diversity

Fracture incidence increases with age regardless of ethnicity or gender. However, Asian and Caucasian women are at greatest risk for fracture. Spine and hip fracture rates are dramatically increasing in Asian

populations, especially in Asians now living in North America or European countries. Despite this, girls and women participanting in exercise studies have been of primarily Caucasian descent. A few epidemiological studies suggest there has been a decrease in physical activity in Asians who immigrated to North America. These data, however, have not been confirmed or well linked with bone density, particularly in young children.

5. Interactions

There are many determinants of bone mineral which may interact more or less with each other. Only preliminary data exists that has examined the interactions between modifiable factors, specifically, calcium and vitamin D intake, exogenous hormone therapy, and physical activity. Furthermore, there is a lack of control for hormonal levels across all age-groups, including puberty, as well as menopausal status. Girls and women should be clearly identified as either pre-, early-, late-, or postpubertal, or pre-, peri- or postmenopausal in all studies of physical activity and bone.

6. Clinical populations

There is a need for exercise intervention studies designed to counter the effects of medication or conditions related to bone loss. These groups include women or children for whom glucocorticoids are prescribed for conditions such as asthma, sarcoidosis and inflammatory bowel disease, and for whom exercise is possible. Studies might also study groups for whom activity is compromised, such as children with cerebral palsy.

F. Implications

1. Research recommendations

The challenge for future research aimed at the prevention of osteoporosis is to design preventative exercise interventions that are effective for increasing peak BMD, and that support the participation of girls and women from all ethnic backgrounds and socioeconomic statuses. We recommend that future research into the prevention of osteoporosis and fracture with physical activity include studies that:

- Design and test (by randomized trial) exercise programs that are easily implemented within existing elementary and high school physical education programs.
- Specifically target pre- and peripubertal girls and pre- and perimenopausal women in randomized exercise intervention trials.
- Include girls and women from minority groups (i.e., Asian, South Asian, First Nations) and utilize exercises that specifically load the spine and the hip. Programs that are of interest to women in a variety of socioeconomic groups and ethnicity's should be designed and tested.
- Are of a longer duration (minimum of three years), and in which hormonal status is well documented and controlled for.
- Longitudinally follow subjects to examine change in BMD and risk of fracture when exercise ceases.

Suggested research questions

1. What is the minimal amount and type of exercise which will be osteogenic for pre-, peri- and pubertal girls, and pre-, peri- and postmenopausal women?
2. Is there an ethnic-specific response to exercise intervention?
3. What is the optimal age to introduce exercise intervention?

2. Policy recommendations

Many questions remain unanswered regarding the optimal “bone-health” exercise program for each stage of life. However, there are enough supportive data to make several recommendations for policy and practice:

- A lifetime of physical activity should include high-impact, weight-bearing activities of varied or diverse movements such as rope skipping, jumping or gymnastics.

- Exercise programs should be started early in life (prepuberty) and maintained into adulthood to attain maximal skeletal benefit.

- Policy makers should encourage changes in current physical education programs to include “bone healthy” activities throughout school years. The prepubertal years are especially important for bone formation, and changing exercise habits is increasingly difficult as adolescence approaches. Thus, targeting elementary school children seems particularly warranted.

- Similarly, there should be reasonable access for women of all ages to activity programs within the community. Also, programs of interest to, and attended by, individuals of all ethnicities across a range of socioeconomic statuses should be developed.

- Immobilization should be avoided at all costs. Women prescribed bedrest or children with limited mobility should partake of some minimal form of weight-bearing or muscular exercise (standing assisted if necessary) in their daily routine.

- Older women should add a routine of exercise aimed at increasing muscular strength and balance to assist in prevention of falls.

- A healthy diet of adequate calcium, vitamin D and total energy intake, in addition to physical activity, is positive for bone.

- Any program of exercise combined with inadequate energy intake which disrupts normal menstrual cycle function should be avoided. Such pursuits have been shown to limit BMD gain during adolescence and potentially to speed bone loss in the premenopausal years.

G. Search Strategies

This review includes studies that were published in English between 1966 and 1998. Studies were located by searching the Medline database, and from reviews of the bibliographies of relevant studies.

Key words searched included:
- bone, bones, bone density, osteoporosis, fracture
- exercise, physical activity

The key bibliographies from important review articles that examined the effect of physical activity on bone density included:
- Bailey, 1996
- Barr, 1998
- Berard, 1997
- Chilibeck, 1995
- Forwood, 1993

Studies were limited to those involving female participants and measuring bone density as the outcome variable as related to physical activity and/or sport-specific exercise. Animal studies were not reviewed but are cited in the introduction and discussion to support human data. Epidemiological studies with fracture risk or falling as an outcome variable were reviewed only for the final section of this review that relates to the prevention of falls.

H. Literature Summary Tables

Table 1. Retrospective studies of childhood activity and adult BMD

Author (n in exercise group)	Mean age (SD) years	Type of exercise	Outcome
Bass et al. [40]	18-35	years of training, age of retirement and hours of training during adolescence evaluated by questionnaire and interview	BMD was 6-16% higher than controls at all sites except the skull
Fehily et al. [110] (182 F)	20-23	sport participation at age 12 evaluated by recall questionnaire	positive correlation between PA (age 12) and radial BMC
Halioua & Anderson [111] (181F)	20-50	activity questionnaire	high lifetime physical activity (>45 mins./wk) associated with greater distal radial BMC
Kannus et al. [29] (105)	27	tennis	3-4 times greater humeral BMC side-side difference in those who started playing at or before puberty
Khan et al. [45] (99)	21-78	hours per week of ballet training as a child, and adult; years of full time ballet; and current physical activity obtained by interview	hours of ballet at ages 10-12 yrs., but not current activity, predicted BMD
Kirchner et al. [46] (26)	18-22	7-day recall questionnaire	gymnasts had greater BMD than controls at all sites
Kriska et al. [112] (223)	58	past physical activity by questionnaire at age 14-21 yrs.	difference in bone area but no difference in BMD according to physical activity levels
Lindholm et al. 1995 [47] (19)	19-23	interview of hours of gymnastics training during pre- and pubertal years	retired gymnasts had higher arm BMC and BMD than controls but no difference at other sites
McCulloch et al. [33] (101)	20-35	adolescent and childhood activity evaluated by recall questionnaire	calcaneal BMD (by QCT) greater in high activity group
Talmage and Anderson, [34] (1200 F)	>25	adolescent activity evaluated by recall questionnaire	higher radial BMC at age 25 in those who did secondary school athletics or heavy farm labour
Tylavsky et al. [35] (705)	17-23	self-administered activity questionnaire during high school and college	radial BMC greater in those with greater physical activity
Valimaki et al. [36] (153)	9-29	activity questionnaire	physical activity (>30 mins./wk) predicted femoral neck BMD
Welten et al. [113] (98 F)	13-28	activity questionnaire 4-6x/year from age 13-28	physical activity not a predictor of lumbar spine BMD

Table 2. Prospective or longitudinal studies of physical activity and bone in children and adolescents (<18 years of age)

Author (n in exercise group)	Mean age (SD) years	Type of exercise	Outcome
Bass et al. [40] (45)	10	elite gymnastics training, 20-30 hrs. per week	30-85% greater increase in BMD at total body, spine and legs
Gunnes et al. [114] (231)	8-17	weightbearing activity measured over 12 months	weightbearing physical activity had the greatest effect on BMD (forearm trabecular) in children below 11 yrs.
Kroger et al. [30] (65)	7-20	3 groups: (I) little or no activity; (II) 3 hrs./week; (III) regular athletes 5 hrs./week	no relationship between PA and any bone measure
Slemenda et al. [22] (32)	6-14	normal sporting activities monitored by questionnaire	weightbearing sporting activity correlated with increased proximal femur BMD

Table 3. Physical activity as a determinant of BMD in premenopausal women

Author (number of subjects)	Determinant	Site and measure of bone mass	Outcome
Alekel et al. [68] (28)	walking by physical activity questionnaire	lumbar spine and proximal femoral BMD	walking associated with increased BMD at both sites
Aloia et al. [69] (24)	physical activity (sensor)	lumbar spine BMD (DPA)	significant correlation that explains 16% of the variance in BMD
Davee et al. [71] (9)	hours per week of physical activity	lumbar spine BMD	not correlated
Halioua et al. [111] (181)	lifetime physical activity by questionnaire	radial BMC/BMD	high lifetime physical activity associated with increased forearm bone mineral
Henderson et al. [72] (115)	physical activity score	hip BMD including subregions	no effect independent of trunk flexor strength or VO_2 max
Kanders et al. [56] (60)	physical activity measured by Minnesota Leisure Time Physical Activity questionnaire	lumbar spine and radial BMD	lumbar spine but not radial BMD related to physical activity
Kirk et al. [70]	physical fitness (VO_2 max)	lumbar spine BMD	correlation between VO_2 max and lumbar BMD (r=0.51)
Mazess & Barden [73] (300)	activity measured by accelerometer and pedometer	lumbar spine (DPA) and forearm (SPA)	activity not correlated with BMD
Sowers et al. [115] (86)	physical activity questionnaire	forearm bone mineral by SPA	no correlation
Stevenson et al. [116] (112)	lack of regular exercise	lumbar spine, proximal femoral BMD	no effect of current regular exercise
Uusi-Rasi et al. [117] (31)	daily walking distance measured	lumbar spine, proximal femur, distal radial BMC	no difference between subjects and controls
Young et al. [118] (450)	physical activity measured by questionnaire	lumbar spine and proximal femoral sites	not correlated
Zhang et al. [119] (264)	physical activity by Caltrac personal activity computer	lumbar spine, midradius, distal radius) - perimenopausal women	significant correlation between physical activity and BMD at spine and forearm sites

Table 4. Exercise-intervention studies in premenopausal women

Author (n in exercise group)	Mean (SD) age in years	Description of programme (duration of sessions X number of sessions per week)	Sites loaded	Effect size (% difference between subjects and controls)
Bassey & Ramsdale [83] (14)	32 (3)	high-impact jumps - daily at home and once weekly under supervision. Jumping component was 6-10 minutes of a one-hour program	hip	hip: 3.4% at the trochanter ($p<0.01$) and different from control ($p<0.05$)
Bassey et al. [83] (7) (controls were crossed over)	30 (4)	high-impact jumps - daily at home and once weekly under supervision. Jumping component was 6-10 minutes of a one-hour program	hip	hip: 4% at the trochanter ($p<0.01$)
Friedlander et al. [82] (32)	28 (7)	aerobics and weight training	hip spine	hip: exercise gained 0.53±2.6, controls lost 1.85±5.7 ($p<0.05$) spine: controls lost 3.0±3.1% using QCT to measure trabecular bone, exercise group, -0.5±4.6 ($p<0.05$)
Gleeson et al. [85]		moderate weight lifting	spine	spine: 1.3%
Heinonen et al. [84] (49)	39 (3)	jumping exercises with high ground reaction forces; aerobics, stepping. One hour, three times a week. Jumping/stepping component took 20 minutes of each session	spine, hip, femur, leg	lumbar spine; exercisers gained 1.8%, controls 0.6%. Femoral neck: exercisers gained 1.6%, controls 0.6%. Significant gains at distal femur, tibia, calcaneum. No change at radius
Lohman et al. [89] (22)	34(3)	strength training at 70-80% of 1RM, 12 exercises, about 1hr., 3 times weekly	hip spine	lumbar spine BMD increased 2.3% and trochanter 1.8%
Rockwell et al. [87] (10)	36 (3)	8-station resistance training including chest press, leg press, overhead press, leg curl, rowing, leg extension, abdominal and back exercises	hip spine arm	spine: -4% in 9 months
Sinaki et al. [86] (67)	30-40 y	non-strenuous weight-lifting exercise program, supervised once a week, done twice more per week	hip spine	No effect at hip, spine or midradius
Smith et al. [120] (80)	Pre- and post-menopausal (age not specified	forearm exercises (4 yrs.)	forearm	radius: 1.28% (mean of left and right radius)
Snow-Harter et al. [121] (22)	20 (1)	jogging or weight lifting	hip spine	spine 1.3 ±1.6% in runners, 1.2 , 1.8% in weight trainers. No change in controls

Table 5. Prospective studies of spinal bone mineral in postmenopausal women: effect of targeted mechanical loading

Reference	Exercises that are likely to have specifically loaded the lumbar vertebrae	Effect size at the lumbar spine (%)
Dalsky et al. [98]	running up and down concrete stairwells	Exercise +5.4 Controls -1.2
Grove et al. [122]	jumping jack exercise (Ground reaction force = 3.3 times body weight); knee to elbow with jump (ground reaction force = 2.8 x body weight)	Exercise +1.7 Controls -6.1
Kohrt et al. 1995 [126]	vigorous walking, jogging, stair-climbing/descending	Exercise +2.3 Controls 0.0
Kohrt et al. 1997 [127] (ground reaction force group)	stairclimbing/descending	Exercise +1.5 Controls +0.1
Kohrt et al. 1997 [127] (strength training group)	standing while doing resistance training including squats	Exercise +1.5 Controls +0.1
Nelson et al. 1991 [128]	walking rapidly wearing a 3.1 kg belt	Exercise +0.5 (QCT) Controls -7.0 (QCT)
Nelson et al. 1994 [129]	dynamic strength training exercises	Exercise +1.0 Controls -1.8
Nichols et al. 1995 [130]	dynamic strength training exercises	Exercise -0.9 Controls +1.4
Welsh & Rutherford 1996 [131]	high-impact step and jumping exercises to load femur and spine. Light weights (1-4 kg) were also used	Exercise +0.2 Controls -0.7

Table 6. Prospective exercise intervention studies in postmenopausal women where intervention was intended to load the hip and femoral neck bone mineral was measured

Author (n in exercise group)	Exercises that are likely to have specifically loaded the hip	Effect size at the femoral neck (%) (p<0.05 unless noted)
Bassey & Ramsdale [99] (20)	50 heel drops (raising bodyweight onto toes and then letting it drop to the floor with the knees and hips extended)	Exercise +0.1 Controls -0.8 (NS)
Bloomfield et al. [123] (7)	stationary cycling against resistance @ 60-80% maximum heart rate	Exercise +0.1 Controls -0.8 (NS)
Heikkinen et al. [124] (13)	exercise designed to load the hip - details not provided in paper	(Trochanter, assuming mean value of 0.820 g/cm^2) Exercise +0.2 Controls -2.1 *
Kerr et al. [125] (28)	weight training	(Trochanter, trained v untrained side) Exercise +1.7 Controls -0.6 ??
Kohrt et al. [126] (8)	walking, jogging, stair climbing	Exercise +3.3 Controls -0.5 **
Kohrt et al. [127] (ground reaction force group) (14)	ground reaction force group: walking, jogging, stair climbing	Exercise +3.5 ** Controls -1.5
Kohrt et al. [127] (strength training group) (13)	joint reaction force group: strength training with free weight and machines. Program included squats and overhead press	Exercise -0.2 Controls -1.5 (NS)
Nelson et al. [128] (18)	waking with a weighted belt (moderate calcium group, i.e., no calcium intervention)	Exercise -1.2 Controls -1.0 (NS)

Author (n in exercise group)	Exercises that are likely to have specifically loaded the hip	Effect size at the femoral neck (%) (p<0.05 unless noted)
Nelson et al. [128] (18)	waking with a weighted belt (high calcium group, i.e., calcium intervention)	Exercise +3.0 Controls -1.2 **
Nelson et al. [129] (20)	exercises using hydraulic resistance machines included back extension and abdominal flexion	Exercise +0.1 Controls -0.8 *
Nichols et al. [130]	isotonic training exercises including back extension, trunk flexion, bench press and seated row	Exercise -1.3 Controls +0.8 (NS)
Welsh & Rutherford [131] (9)	high-impact step and jumping exercises to load femur and spine. Light weights (1-4 kg) were also used	Exercise +1.6 ** Controls -1.9

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VII. ESTROGEN-RELATED CANCERS

Kristin L. Campbell, B.Sc., Susan R. Harris, Ph.D.

A. Chapter Overview

What do we know?

Physical activity is one of the "levers" that can be manipulated toward the primary prevention of estrogen-dependent cancers (breast, endometrial, and ovarian cancer). Although the studies varied as to the types of physical activity examined (recreational, occupational, or a combination of the two), the sample sizes, and the nationalities and ages of the women involved, there was strong support for the protective benefits of physical activity, particularly for endometrial and ovarian cancers.

What do we need to research?

There is a need for large prospective, randomized trials to provide stronger evidence about the relationship of physical activity to risks for estrogen-dependent cancers.

There is also a need for more studies to consider issues of diversity, both from the perspective of the research participants as well as the type of physical activity. In the work that has been done there was little mention of race/ethnicity, socioeconomic status, or sexual preference. With respect to exercise, failure to consistently operationalize or standardize the independent variable of "physical activity" is a significant limitation.

What should we do?

Exercise can and should be a critical variable in promoting the overall health of women and girls. It is likely that the role of health care professionals will become increasingly important in the promotion of exercise in preventing a variety of diseases in women of middle and older age groups. Health care and physical activity professionals can, and should, assist women at risk for such cancers to develop lifelong exercise habits that may serve to mitigate those risks. Other recommendations include:

- An ongoing, regular program of moderate aerobic exercise and strength training for the rehabilitation of women who have been treated for breast cancer and for women who are at risk of developing breast, endometrial, or ovarian cancer.
- The promotion of the benefits of regular exercise to adolescent girls and young women, not only with the goal of preventing estrogen-related cancers, but also for the prevention of heart disease, colon cancer, and osteoporosis.
- The maintenance of life-long habits of recreational exercise in women of all ages.
- Targeting pre- and postmenopausal women who have been treated for estrogen-related cancers and who are unable to partake in hormone replacement therapy.

B. Introduction

Estrogen-dependent cancers present a major health risk to Canadian women. Breast cancer remains the most common type of cancer in women, accounting for 30.6% of newly diagnosed cancers in women. Endometrial cancer, involving the lining of the uterus, comprises another 5% of new cancers in women, with ovarian cancer accounting for 3.6%. Together, the estrogen-related cancers account for nearly 40% of all new cancer cases in women [1].

Breast cancer continues to be the leading cause of death for women aged 35-54 years. The incidence of breast cancer has risen steadily during the past two decades, while the incidences for endometrial and ovarian cancers have declined slightly during this same time period [1]. Although the number of men who

die from cancer annually exceeds the number of women, the potential years of life lost for women is greater because of their longer expected lifespan and because some common female cancers (e.g., breast cancer) occur at a much younger age than common male cancers (e.g., prostate cancer).

Currently identified risk factors for estrogen-dependent cancers, such as familial susceptibility, menstrual cycle characteristics, reproductive behaviors, and socioeconomic status, are not readily alterable. However, in an effort to better understand these risk factors and, in turn, to work toward reducing the incidence of these cancers, there has been an important shift during the past two decades toward investigating the primary prevention of cancer.

The hormone estrogen is considered to be a key factor in the etiology of breast, ovarian, and endometrial cancers. According to Friedenreich and Rohan [2], this has led to investigation of therapeutic interventions that inhibit the activity of estrogen, such as the clinical trials examining the use of tamoxifen in preventing breast cancer in women at high risk [3], and the use of gonadotrophin-releasing hormone agonists to produce a reversible menopause at an early age [4]. However, these hormone manipulations are not without side effects [4-6].

Another aspect of primary prevention that has been investigated recently, and that does not involve chemopreventive agents, is the impact of lifestyle in minimizing the risk of estrogen-related cancers, of which dietary practices and exercise have received the most attention [6]. The influence of exercise, or physical activity in general, on risk for estrogen-related cancers will be the focus of this review.

1. Mechanism of physical activity in the prevention of estrogen-related cancers

The general health benefits of physical activity and exercise have been well documented, especially in the prevention of cardiovascular disease. However, the link between exercise and risk reduction of female cancers is less clear. Kramer and Wells [7] have summarized the hypothesized mechanisms for the role of exercise in reducing the risk of estrogen-related cancers as follows:

1) maintenance of low body fat and moderation of extraglandular estrogen;
2) reduction in the number of ovulatory cycles and subsequent diminution of lifetime exposure to endogenous estrogen;
3) enhancement of the natural immune function; and
4) association of other healthy lifestyle factors [7; p. 322].

Recent research has focused primarily on the first two hypotheses.

Physical activity may minimize the development of estrogen-related cancers by reducing body mass, thus lowering the availability of extraglandular estrogen. Adipose tissue is able to convert other hormone derivatives into estrogen, thus increasing the bioavailability and activity of estrogen, which is thought to be a prime factor in the development of breast cancer [8, 9]. Obesity has also been implicated strongly in the development of endometrial cancer, leading to recent studies that have examined the role of physical activity in minimizing the risk of this type of cancer [10-12]. Exercise may help to maintain a lower body weight, thus reducing the amount of extraglandular estrogen stored in fat tissue.

Physical activity in adolescents has been shown to delay the onset of menarche, thus reducing the number of ovulatory cycles and the overall lifetime exposure to estrogen [13]. Girls with early menarche establish ovulatory cycles more quickly than those with later onset of menstruation, which increases exposure to ovarian hormones [13]. The relative risk of breast cancer decreases as age of menarche increases [14]. Young women who experience menarche before age 12 have a risk of breast cancer that is twice that of women whose age of menarche is 13 or older [15]. Early menarche is also a risk factor for endometrial and ovarian cancers [7].

A further reduction in cumulative estrogen exposure is associated with early menopause, which has also been linked to physical activity [4]. Women who experience natural menopause before age 45 have only half the breast cancer risk of women whose menopause occurs after age 55 [4, 15]. Surgically induced

menopause, i.e., through oophorectomy, also has a protective effect, especially if it occurs before the age of 45. Late menopause has also been linked with an increased risk for endometrial and ovarian cancer [7].

The association between exercise-induced enhancement of immune system function and reduced risk for cancer in humans is still speculative [16], although exercise has been shown to improve the resistance of animals to experimentally induced tumors [17], including mammary tumors [18].

Healthy lifestyle habits that often co-exist with regular exercise practices include factors that have been associated with a diminished risk of estrogen-dependent cancers. Alcohol consumption, for example, has been shown to be associated with increased risk for breast cancer [19], leading to the assumption that women who exercise may also drink less, thus lowering their risk for breast cancer. Regular exercisers also tend to have healthier diets, including higher consumption of fibre and lower consumption of fat, both of which have been linked with a lower incidence of breast cancer. Regular exercise also tends to reduce overall body fat which, in turn, reduces the risk for postmenopausal breast cancer and endometrial cancer.

In summary, there are a number of possible mechanisms that may contribute to the reduction of estrogen-dependent cancers in women who are physically active.

C. Literature Review

In the past two decades, the possible link between physical activity and reduced risk of estrogen-related cancers has been the focus of 28 studies, the majority of which support the plausibility of such a link. However, methods of investigation have varied as to the type of exercise evaluated, the population examined, the points in the lifespan that were assessed, and the methods of data collection that were used. This review will consider recent studies, as well as other significant review articles on this topic [2, 6, 7, 20], and discuss the strength of the evidence for the relationship between physical activity and the prevention of estrogen-related cancers.

1. Physical activity and breast cancer risk

Far more research has been undertaken to examine the effects of physical activity on the development of breast cancer than on either ovarian or endometrial cancers. Since 1985, 23 studies have been published that have examined the relationship of physical activity and the risk of breast cancer; four of these studies examined endometrial and ovarian cancer outcomes also, in addition to breast cancer [21-24].

Twelve of these were case-control studies [20, 25-30, 31-35], four were prospective cohort studies [9, 36-38], six were retrospective cohort studies [21-23, 39-41], and one was a record-linkage study [24]. These studies were further classified by type of physical activity investigated (i.e., recreational or leisure activity vs. occupational activity). Results are summarized in Table 1.

Of the studies that examined recreational physical activity, only eight demonstrated a protective effect of recreational exercise on breast cancer risk [21, 22, 25, 30-34]. This was particularly true for women who participated in vigorous exercise at least once a day. For example, in one study these women showed a 50% reduction in breast cancer risk [34]. In contrast, five other studies examining recreational physical activity found no significant effect of exercise on risk of breast cancer [20, 26, 35, 37, 39].

Of the studies examining only occupational activity, all four showed a protective benefit of increased occupational activity [24, 27, 29, 40]. Several groups of investigators suggested that neither recreational physical activity nor occupational activity alone was representative of overall levels of physical activity and, consequently, they undertook studies to measure the association of all types of physical activity with breast cancer incidence. Results of five such studies [23, 28, 36, 38, 41] all suggest a protective effect of physical activity on breast cancer risk. However, the results of the Framingham Heart Study [9] actually suggested an increased risk for breast cancer among the most active women. In summary, seventeen of

the breast cancer studies showed a protective benefit of physical activity, four showed no association, and one reported a negative effect of physical activity.

2. Physical activity and risk for endometrial cancer

Endometrial cancer invades the lining of the uterus and is the second most common reproductive cancer in Canadian women, accounting for 5% of all new cases of female cancers [1]. Endometrial cancer has been strongly linked to obesity [10-12]. Since 1985, nine studies have been published that have examined the relationship of physical activity to the development of endometrial cancer. These include the four studies cited previously that also assessed breast and ovarian cancer outcomes [21-24]. Five of these were case-control studies [10-12, 42, 43], three were retrospective cohort studies [21-23], and one was a record-linkage study [24]. These studies are summarized in Table 2.

Of the five studies that examined both recreational and occupational activity [10-12, 42, 43], four reported that decreased overall activity levels were associated with greater risks for endometrial cancer. Olson and colleagues [43] found a risk reduction related to vigorous recreational exercise but found no relationship between occupational physical activity and endometrial cancer. Frisch and colleagues [21, 22] examined recreational activity only and found that physical activity before, during, and after college reduced the risk for all types of reproductive cancers, including endometrial cancer. Similarly, Hirose and colleagues [42] reported reduced risk of both endometrial cancer and cervical cancer secondary to increased levels of physical exercise. In the final study, which examined occupational activity only, Zheng and colleagues [24] reported an increased risk of endometrial, breast, and ovarian cancers in women with the most sedentary jobs (i.e., those that required the longest periods of sitting).

3. Physical activity and risk for ovarian cancer

Ovarian cancer is the least common of the estrogen-related cancers but it is often fast-growing, extremely difficult to diagnose, and represents the fourth leading cause of cancer-related deaths in Canadian women [1]. Risk factors are less well-established than for the other female reproductive cancers but are presumed to include high socioeconomic status, nulliparity, late age at first pregnancy, positive family history of breast or ovarian cancer and, as mentioned previously, early menarche and late menopause. Physical activity is hypothesized to have a protective benefit against developing ovarian cancer similar to its role in preventing breast and endometrial cancers.

Only five studies investigated the role of physical activity in the development of ovarian cancer, four of which also examined breast and endometrial cancers. In a retrospective cohort design examining recreational physical activity, Frisch and colleagues [21, 22] showed that non-athletes in their sample had an increased risk of reproductive system cancers compared to those engaging in long-term athletic endeavors. Similarly, Pukkala and colleagues [23] reported a non-significant trend for the role of occupational and recreational physical activity in protecting against ovarian cancer. Zheng and colleagues [24] reported a non-significant trend in examining the relationship of sedentary occupations to the development of ovarian cancer.

In a prospective cohort study of postmenopausal women, Mink and colleagues [44] reported a 1.5-fold greater risk of ovarian cancer in women who engaged in regular leisure-time physical activity versus those who were sedentary. Women who engaged in physical activity showed a 2.5 times greater risk than the sedentary group. Consequently, four of these five studies support a positive relationship between physical activity and risk of developing ovarian cancer; in contrast, the study by Mink and colleagues [44] showed a negative effect. The studies examining the links between physical activity and ovarian cancer are summarized in Table 3.

D. Summary

Since publication of the first study that examined the relationship of physical activity to breast cancer by Frisch and colleagues in 1985, there has been a rapidly expanding interest in the role of exercise in

preventing estrogen-related cancers. Twenty-two of the 28 studies cited in this review have been published within the past five years. As Pritchard [45] stated recently in her discussion of the challenges of trying to prevent breast cancer:

> In an environment where prevention and maintenance are the watchwords of individual and group approaches to health, there are few levers to manipulate in the primary prevention of breast cancer [45; p. S124].

Results of the majority of studies published to date suggest that physical activity is one of the "levers" that can be manipulated toward the primary prevention of estrogen-dependent cancers. Although the studies varied as to the types of physical activity examined (recreational, occupational, or a combination of the two), the sample sizes, and the nationalities and ages of the women involved, there was strong support for the protective benefits of physical activity, particularly for endometrial and ovarian cancers.

Of the 23 studies that examined the relationship of physical activity to breast cancer, 17 showed at least a slight to modest protective benefit. Five studies revealed no association between levels of physical activity and breast cancer risk [20, 26, 35, 37, 39], and one showed an unexpected positive relationship between leisure-time exercise levels and risk of breast cancer [9]. All nine studies examining the relationship of physical activity to endometrial cancer supported a protective benefit. Four of the five studies of ovarian cancer risk supported a protective benefit of physical activity, although one showed an inverse relationship [44].

E. Gaps in the Literature

Although a clear preponderance of studies supports the benefits of physical activity in reducing estrogen-related cancers, it is important to note that due to the design of these studies, the evidence cannot be considered to be conclusive. The need for large prospective, randomized trials to provide stronger evidence about the relationship of physical activity to risks for estrogen-dependent cancers is obvious. Large, long-term prospective studies, such as those currently in progress to examine the effects of dietary fat on the incidence of breast cancer, are needed to enhance the evidence base for recommending exercise in the primary prevention of estrogen-related cancers.

There is also a need for more studies to consider issues of diversity, both from the perspective of the research participants as well as the type of physical activity. Although these studies included women from a variety of different nationalities (e.g., North American, Finnish, Norwegian, Turkish, Swiss, Italian, Chinese, Japanese), there was little mention of other characteristics of diversity when describing samples, such as race, ethnicity, socioeconomic status, or sexual preference. With respect to exercise, failure to consistently operationalize or standardize the independent variable of "physical activity" is a significant limitation of this body of research.

Nonetheless, a clear majority of the recent cohort and case-control studies supports the beneficial effects of various types of physical activity and suggests that recreational or leisure-time exercise may be a manipulable "lever" in reducing a woman's risk for breast, endometrial, and ovarian cancer. As Thune and colleagues [38] reported in their large, prospective cohort study of Norwegian women:

> There was a significant inverse dose-response relationship between leisure-time activity and the risk of breast cancer [38; p. 1273].

Similar to the findings of Bernstein and colleagues [25], in a case-control study in southern California that demonstrated a 50% risk reduction of breast cancer in young women who exercised four hours per week, the Norwegian study showed that four hours of exercise per week conferred a 72% reduction in breast cancer risk among young women (<45 years) with lean body mass [38].

F. Implications

1. Research recommendations

Due to the limitations of the current studies in establishing true cause-and-effect relationships, future research should include large, randomized controlled trials in which pre-menopausal women are randomly assigned to various levels of exercise intensities and are followed prospectively for at least ten years. Although it is difficult to rigidly control for recreational exercise practices, a current long-term randomized controlled trial in which women at risk for breast cancer have been randomly assigned to an extremely low-fat diet vs. a regular diet has had remarkable levels of compliance in both groups.

In addition to characteristics such as age, nationality, and menopausal status, future studies should collect information concerning the subjects' race, ethnicity, socioeconomic status, and sexual preference in order to analyze the effects of exercise on preventing estrogen-related cancers in women from diverse backgrounds.

Suggested research questions

1. Does recreational physical activity during adolescence and young adulthood minimize the risk of developing premenopausal estrogen-related cancers?
2. In women who have been diagnosed with estrogen-related cancers, can regular physical activity reduce the risk of cancer recurrence?
3. In women with a history of estrogen-related cancers (who are unable to partake in hormone replacement therapy), can recreational physical activity reduce the risk of osteoporosis and heart disease?

2. Policy recommendations

These recent results suggest that modifiable lifestyle factors (i.e., amount and intensity of recreational exercise) can be manipulable "levers" in the prevention of estrogen-related cancers. Combined with the beneficial effects of regular moderate exercise on cardiopulmonary fitness and bone density, it appears that exercise can and should be a critical variable in promoting the overall health of women. It is likely that the role of health care professionals will become increasingly important in the promotion of exercise in preventing a variety of diseases in women of middle and older age groups.

Recently developed clinical practice guidelines for the rehabilitation of women who have been treated for breast cancer [46] have recommended "an ongoing, regular program of moderate aerobic exercise", based on the 1990 recommendations of the American College of Sports Medicine [47]. Such a program would also be appropriate for women who are at risk for developing breast, endometrial, or ovarian cancer. The ACSM recommendations include aerobic training of 20-60 minute sessions for at least 3-5 days per week, at 60-90% of maximum heart rate. In addition, strength training of a "moderate intensity" should be carried out at least twice a week, with 8-12 repetitions of 8-10 exercises aimed at conditioning the major muscle groups.

Increasing evidence over the past two decades supports the beneficial effects of physical activity in reducing a woman's risk for developing breast, endometrial, and ovarian cancers. A number of studies have supported the effects of work-related physical activity, whereas others have supported the role of recreational or leisure-time physical activity. Because recreational activity is a more readily "modifiable" lifestyle factor than occupational activity, it seems logical that moderate levels of regular aerobic exercise should be recommended to women who are at risk for estrogen-related cancers.

In order to support the prevention of estrogen-dependent cancers through physical activity, health care and exercise professionals should:

- encourage regular, moderate-intensity recreational exercise for at least four hours per week for adolescent girls and young women, especially those who are at increased risk for developing breast, ovarian, or endometrial cancers.
- promote the benefits of regular exercise to adolescent girls and young women, not only with the goal of preventing estrogen-related cancers, but also for the prevention of heart disease, colon cancer, and osteoporosis.
- encourage maintenance of lifelong habits of recreational exercise, (i.e., four hours/week) in women of all ages.
- specifically target pre- and postmenopausal women who have been treated for estrogen-related cancers and who, therefore, are unable to partake in hormone replacement therapy. These women will significantly benefit from regular aerobic exercise for the prevention of heart disease, as well as from high-impact, weight-bearing exercises (e.g., jogging, rope-jumping, or weight-lifting) to assist in the prevention or minimization of osteopenia and osteoporosis.

The available evidence, albeit limited, suggests that regular exercise may be an important tool in the prevention of estrogen-dependent cancers. Health care and physical activity professionals can, and should, assist women at risk for such cancers to develop lifelong exercise habits that may serve to mitigate those risks.

G. Search Strategies

The literature search was restricted to English publications from 1985 through June, 1998. The following databases were consulted in the search:

- Index Medicus (MEDLINE)
- Cumulative Index of Nursing and Allied Health Literature (CINAHL)
- WinSPIRS

The key search terms included the following text words:

- breast cancer, estrogen-related cancers
- physical activity, exercise

Reference lists from previously identified research articles were also used to locate additional references. Only those articles that examined the effects of exercise or physical activity on estrogen-related cancers were reviewed, excluding those that studied the impact of other factors, such as the influence of diet on risk for breast cancer.

H. Literature Summary Tables

The following tables organize the literature reviewed with respect to the type of estrogen-related cancer being studied. Only those articles that investigated the relationship between physical activity and cancers specifically are included. Reports and analyses that deal with more general factors such as the etiology of different types of cancers, prevalence, or health consequences for women, can be found in the references section only.

Table 1: Studies on breast cancer and physical activity

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Albanes et al. [36]	• prospective cohort	• women in NHANES 1 study (n=7407)	• recreational and non-recreational activity	• reduced risk of breast cancer in postmenopausal women with high levels of non-recreational activity
Bernstein et al. [25]	• case-control	• premenopausal women living in Los Angeles County (n=1090)	• recreational physical activity	• premenopausal women who exercised 1-3 hrs./week reduced their breast cancer risk by 30% • those who exercised four hrs./week reduced their risk by 50%
Chen et al. [26]	• case-control	• women with breast cancer in western WA state (n=747) • randomly selected controls (n=961)	• leisure-time physical activity	• no associations between leisure-time recreational activity and breast cancer risk
Coogan et al. [27]	• case-control	• women diagnosed with breast cancer in 4 U.S. states (n=4863) • randomly selected controls (n=6783)	• occupational activity	• significant decreasing trend (p = 0.007) from sedentary occupations to heaviest work
D'Avanzo et al. [28]	• case-control	• multi-centre study in Italy • n=2569 cases • n=2588 controls	• recreational activity • occupational activity	• protective benefit of both occupational and leisure physical activity • stronger for those <60 yrs. and with more education
Dorgan et al. [9]	• prospective cohort	• women assessed for physical activity (1954-1956) for Framingham Heart Study (n=2321)	• occupational activity • recreational activity	• women who were more active had an increased risk of breast cancer
Dosemeci et al. [29]	• case-control	• Turkish women with breast cancer (n=241) • matched with cancer controls (n=241)	• occupational physical activity (energy expenditure & sitting time)	• trend for increased risk of breast cancer for women who sat >6 hrs./day during work vs. 2-6 hrs./day and <2 hrs./day

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Friedenreich & Rohan [30]	• case-control	• Australian breast cancer cases (n=444) • matched with controls (n=444)	• recreational physical activity	• declining breast cancer risk with increasing levels of physical activity • most evident with vigorous activity
Frisch et al. [21, 22]	• retrospective cohort	• former college athletes (n=2622) • non-athletes (n=2776) from 1923-81	• pre-college and college training activities • current exercise participation	• lower lifetime prevalence of breast cancer in college athletes vs. non-athletes
Gammon et al. [20]	• case control	• women under 45 in GA, NJ and WA • n=1668 cases • n=1505 controls	• recreational activity	• no association between breast cancer and levels of recreational physical activity
Hirose et al. [31]	• case-control	• Japanese women >18 years • n=1186 cases • n=23,163 controls	• recreational activity (for health)	• protective effect of physical activity for pre- and postmenopausal women
Hu et al. [32]	• case-control	• Japanese women aged 25-65 • n=157 cases • n=369 age and residence matched	• recreational activity (self-report)	• trend toward reduced pre-menopausal breast cancer with high energy expenditure in teenage years
McTiernan et al. [33]	• case-control	• women aged 50-64 with breast cancer in western WA state (n=537) • randomly selected controls (n=492)	• recreational activity	• weak negative association between physical activity and risk of breast cancer
Mittendorf et al. [34]	• case-control	• breast cancer cases from New England in 1988-91 (n=6888) • matched controls (n=9539)	• participation in strenuous physical activity or team sports from ages 14-18 and 18-22	• women who reported any strenuous activity from ages 14-22 yrs. had a modest decrease in risk of breast cancer • 50% risk reduction with vigorous exercise at least 1X/day

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Paffenbarger et al. [39]	• prospective cohort	• former college athletes (n=4706) from 1916-50	• college sports participation	• breast cancer risk was unrelated to college sports participation
Pukkala et al. [23]	• retrospective cohort	• female physical education teachers (n=1499) • language teachers (n=8619) in Finland	• occupational, domestic, leisure physical activity • organized sports participation	• some protective benefits may be provided by physical activity but a larger cohort is needed for conclusive results
Rockhill et al. [37]	• prospective cohort	• female nurses (ages 25-42) assessed by survey from 1989-95 for activity at ages 18-22 and currently (n=116,671)	• recreational activity (non-occupational)	• higher levels of activity were not associated with reduced risk of breast cancer at either time point
Taioli et al. [35]	• case-control	• breast cancer cases in New York City (n=617) • matched controls (n=531)	• regular, strenuous activity for 20 min., 3x/wk for >1 yr. • from15-21, 22-44, and 45+ years	• no significant effect on breast cancer risk was observed
Thune et al. [38]	• prospective cohort	• women aged 20-54 yrs. who enrolled in health surveys from 1974-78 and 1977-83 (n=25,624)	• leisure and work activity	• women with greater leisure time and occupational activity had reduced risk of breast cancer • greater in premenopausal vs. postmenopausal women who exercised regularly, women <45 yrs., leaner women, and those who exercised >4 hrs./week
Vena et al. [40]	• retrospective cohort	• deceased women from WA state between 1974-1979 (n=25,000)	• occupation listed on death certificate	• breast cancer risk was elevated slightly in women who had sedentary jobs

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Vihko et al. [41]	• retrospective cohort	• female physical education teachers (n=202) • language teachers (n=108)	• assumed, based on occupation and college training	• lower incidence of breast cancer in pre-menopausal women who were physically active
Zheng et al. [24]	• retrospective cohort	• breast cancer cases in Shanghai (n=2736)	• occupational census data	• increased breast cancer incidence in women whose jobs involved long periods of sitting or low energy expenditure

Table 2: Studies on endometrial cancer and physical activity

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Frisch et al. [21, 22]	• retrospective cohort	• former college athletes (n=2622) • non-athletes (n=2776) from 1923-81	• pre-college and college athletic training levels • current exercise	• lower risk of reproductive system cancers with long-term physical activity
Hirose et al. [42]	• case-control	• Japanese women with endometrial cancer (n=556) • cervical cancer (n=145)	• physical exercise	• risk reduction in both endometrial and cervical cancer with exercise
Levi et al. [10]	• case-control	• Swiss & Italian women with endometrial cancer(n=274) • hospital-based controls (n=572)	• occupational activity • recreational activity	• endometrial cancer risk was reduced by moderate or high physical activity
Olson et al. [43]	• case-control	• women with recently diagnosed endometrial cancer (n=232) • community controls (n=631)	• occupational activity • recreational activity	• women with histories of moderate amount of vigorous exercise had half the risk of developing endometrial cancer • no relationship of occupational activity to endometrial cancer risk

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Pukkala et al. [23]	• retrospective cohort	• female physical education teachers (n=1499) • language teachers (n=8619) in Finland	• occupational, domestic, leisure activity • organized sports participation	• some protective benefits may be provided by physical activity but a larger cohort is needed for conclusive results
Shu et al. [11]	• case-control	• endometrial cancer cases in Shanghai (n=268) • controls(n=268)	• occupational, domestic, and leisure physical activity	• women with sedentary jobs had elevated risk for endometrial cancer
Sturgeon et al. [12]	• case-control	• endometrial cancer cases from 7 U.S. metropolitan medical (n=405) • controls (n=297)	• recreational and non-recreational (including occupational) activity	• physically inactive women have increased risk for endometrial cancer
Zheng et al. [24]	• retrospective cohort	• Chinese females in Shanghai (n=7566)	• occupational census data	• increased incidence of endometrial cancer in women with sedentary jobs (involving long periods of sitting or low energy expenditure)

Table 3: Studies on ovarian cancer and physical activity

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Frisch et al. [21, 22]	• retrospective cohort	• former college athletes (n=2622) • non-athletes (n=2776) from 1923-81	• pre-college and college athletic training levels • current exercise	• lower risk of reproductive system cancers with long-term physical activity
Mink et al. [45]	• prospective cohort	• large cohort(n=31,396) of post-menopausal women • n=97 with ovarian cancer	• physical activity	• women with moderate and high levels of physical activity had relative risks of ovarian cancer of 1.4 and 2.1 compared to women with low physical activity

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Pukkala et al. [23]	• retrospective cohort	• female physical education teachers (n=1499) • language teachers (n=8619) in Finland	• occupational, domestic, leisure activity • organized sports participation	• some protective benefits may be provided by physical activity but a larger cohort is needed for conclusive results
Zheng et al. [24]	• retrospective cohort	• Chinese females in Shanghai (n=7566)	• occupational census data	• increased incidence of ovarian cancer in women with sedentary jobs (involving long periods of sitting or low energy expenditure)

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VIII. THE ALLEVIATION OF MENOPAUSAL SYMPTOMS

Susan Crawford, Ph.D.

A. Chapter Overview

What do we know?

The benefits of exercise to mental well-being, as well as to the bone and cardiovascular health of women in midlife, are clear. As well, the mechanisms by which physical activity has been proposed to reduce the vasomotor symptoms of menopause and the psychological distresses of midlife are well-founded.

We also know that hormonal and menopausal status does not affect the capacity of a physically active lifestyle or acute bouts of exercise to generate psychological benefits.

What do we need to research?

There have been a number of problems with the studies that have been done to date. They include:

- Lack of diversity: the conclusions of the studies that have been done to date are limited by the lack of diversity in the samples of research participants.
- Small samples of women: it is possible that women who were experiencing more severe symptoms participated less often in physical activity than did those whose midlives had been less distressing.
- The measurement of physical activity: due to difficulties in capturing participation rates based on physical activity patterns for men, self-report techniques, and the difficulties assessing the activities in the context of daily life.

What should we do?

Based on the research in the areas of cardiovascular health, osteoporosis, estrogen-related cancers, and menopausal symptoms, physical activity programs designed specifically for women in midlife are warranted. Programmers must recognize that these women may hold negative associations with the notion of exercising, have less experience with contemporary forms of exercise, and bear multiple roles (job, household, caregiving for children and/or aging parents) due to their lifestyle and generation. Opportunities for enjoyable physical activity must therefore present themselves in the context of these realities. As well,

- Health practitioners should be encouraged to strongly recommend physical activity to their patients and guide them with specific ideas and resources.
- Health educators must initiate the diffusion process. Women in midlife need to feel confident that regular physical activity is an achievable and unselfish goal.

B. Introduction

Menopause is a natural physiological process that occurs in response to the aging of the ovaries [1]. Strictly defined, it is the last occurrence of menstruation, which is the most overt event of the climacteric, or passage of a woman back to non-reproductive life. As this is a process, the perimenopausal period usually encompasses the few years preceding cessation of menstruation, and the year following it [2]. The average age of menopause is 50 years [2, 3, 1]. The life expectancy for Canadian and American women is now better than 80 years, consequently a woman can live approximately one third of her life in a post-menopausal state. The ramifications of this with respect to women's bone density and cardiovascular health are discussed elsewhere in this review series (see Chapters 5 and 6).

Given the high use of psychotropic drugs by postmenopausal women [4], it would appear that mental health and general well-being are similarly challenged by this transitional period and the years following. In fact, Shaver [5] reported that close to one-quarter of health care visits are made by women over 44 years of age,

> often for hot flashes, sleep problems, and depressed mood, attributable, at least in part, to ovarian hormone shifts with menopause [5; p. 469].

Feminists have been critical of the medical system and the pharmaceutical industry for this heightened medicalization of menopause and mid-to-late life in women [6-8]. It may, however, have already evolved into a characteristic of our North American culture, that menopause is considered by both physician and patient to be a medical condition. Non-medical “treatments” of menopause-related distresses may be desirable from an economic standpoint, but they will have to be proven credible, effective, and feasible in the eyes of middle-aged women in order to be accepted in place of current practices.

The role of physical activity in attenuating the symptoms of menopause and improving the well-being of women experiencing menopause has received very little attention in the academic research agenda. Much of the investigation into the benefits of physical activity during a woman’s midlife focuses on its relationship to bone density, cardiovascular disease, and changes in body composition. Of the studies that examine psychological, psychosomatic, and physical symptoms of menopause, most have focused on clinical samples and, as such, likely over-represent women with abnormally negative experiences [1]. Few studies have looked at the possible role of physical activity in the attenuation of these symptoms.

Disturbances that have been associated with the menopausal transition include vasomotor symptoms of hot flushes (or flashes) and night sweats; psychosomatic symptoms including palpitations and dizziness; and psychological symptoms such as tiredness, forgetfulness, irritability, nervousness, and loss of concentration [2, 6, 9]. Of these, only vasomotor symptoms have been clearly linked to decline in estrogen associated with menopause [1, 9]. Psychosomatic and psychological symptoms have been suggested as secondary effects related to sleep disturbances caused by hot flushes [2], the result of neuroendocrine shifts, such as declining catcholamines, as part of the aging process [1, 5]. They have also been attributed as reactions to major life changes commonly experienced by women in middle-age [2]. Importantly, the recognition of symptoms at the menopause appears to be socially and culturally driven [2, 9].

1. Vasomotor symptoms

It has been estimated that up to 80% of women undergoing either natural or surgical menopause experience sweating and hot flushes [2, 10]. Of those seeking medical care for these symptoms, most report experiences of hot flushes for more than a year, with almost half of the women symptomatic for up to five years post-menopause [2]. Hot flushes are caused by a sudden and transient increase in sympathetic drive during which thermoregulation is altered and body heat loss responses are suddenly elevated [9]. While the subjective experience of flushing may last for one to five minutes, women are typically awakened from sleep by both the physiological changes and subjective experience associated with flushing [2]. This can result in decreased REM sleep, as well as sleep latency, in women not taking hormone replacement therapy (HRT) [11]. The Special Advisory Committee on Reproductive Physiology [2] suggests that nocturnal hot flushes subject perimenopausal women to sleep deprivation. As a result, complaints of nervousness, irritability, lack of concentration, and diminished quality of life are likely the outcomes.

Associations between endocrine flux and hot flushes have been well documented [2], yet the etiology of the phenomenon is still not well understood [2, 5]. Among the suggested causes of this temporary aberration in thermoregulation are changes in hypothalamic neurotransmitter activity [2, 10]. Neuroendocrine imbalances in norepinephrine, beta-endorphins, and serotonin resulting from estrogen withdrawal have been speculated to be the mediating events [2, 5, 10]. Physical activity is known to affect the levels of these hormones, and as such has been suggested as a mechanism for the reduction in the incidence of hot flushes [5, 12].

C. Literature Review

The potential impacts of physical activity on the psychological well-being, bone and cardiovascular health of women are being explored by other reviewers, therefore they will not be discussed in this section. Physical activity will be examined for its potential to alleviate menopausal symptoms that appear to be directly mediated by hormone changes, specifically hot flushes. While these symptoms may indirectly affect mood through their effect on sleep quality, this review did not venture into the literature that describes the relationship between physical activity and sleep. Another related theme that has not been investigated in this review is the speculation that physical activity, through its ability to reduce adiposity, may subsequently lower serum estrogen levels, thereby aggravating menopausal symptoms [10].

The following review examines six observational studies that investigated the associations among physical activity, psychological parameters, and vasomotor symptoms in premenopausal, perimenopausal, and postmenopausal women [1, 2, 6, 8, 10, 13]. A single prospective study explored the association of changes in physical activity with differences in depression and stress measures over a three-year midlife interval [14]. Two additional studies investigated the effects of interventions, comprised of acute bouts of exercise, on psychological measures and symptoms of menopause [1, 15].

In general, the research on how exercise might reduce the vasomotor symptoms and mood changes that appear to accompany menopause has been limited to a few studies. These studies have been based on cross-sectional measures of self-reported physical activity and its associations with scores on mood and other psychological tests and, in some studies, ratings of hot flushing. Slaven and Lee [1] examined mood-state, exercise pattern, and physical fitness in cohorts of women who reported to be either regular exercisers or sedentary. These included premenopausal women (n=30), aged 37-52 years, and postmenopausal women who were not taking HRT (n=30) aged between 40 and 65 years. Multivariate analysis of variance indicated that physical activity was associated with significant benefits in all six subscales of the mood questionnaire, and that there were no significant effects for the interactions of hormonal status and exercise.

A recently published extension of this study [15] included the above groupings, plus an additional cohort comprised of postmenopausal women receiving HRT (n=41, mean age 53 years). The procedures were similar, with the addition of a 37-item questionnaire to assess well-being. Univariate analysis for exercise participation found significant effects on mood state as well as vasomotor and somatic symptoms, anxiety, sleep problems and other indicators of well-being. Multivariate analysis indicated that there was also a significant effect for menopausal status on measures of well-being. Once again, there were no significant effects for the interaction of menopausal status and exercise participation on measures of either mood or well-being. The postmenopausal exercisers scored consistently better on well-being scales than those who did not participate in regular physical activity. The authors suggest these data indicate that middle-aged women who are physically active may experience significantly lower levels of menopause-related distress, irrespective of their hormone status.

Although these two intervention studies by Slaven and Lee [1, 15] established that the experience of symptoms is reduced, and sense of well-being and mood are improved during and immediately subsequent to an acute bout of exercise, it is difficult to explain how parameters such as sleep problems could be perceived by respondents to be reduced given the limited time passage between the pre- and post-tests.

A large cross-sectional study examining the health of a sample of Australian women (n=555) in midlife explored, among other variables, the relationships between leisure-time physical activity and women's experience of symptoms during natural menopause [13]. While the level of physical activity had no significant effect on the women's experience of menopausal symptoms (including vasomotor), it was associated with better self-rated health. Earlier analysis of data from the same survey examined the relationship between exercising at least once a week and measures of affect and overall well-being in 1503 women between the ages of 45 and 55 years [6]. Those individuals who exercised at least once a week scored lower on the negative affect scale ($p<0.01$), higher on the positive affect scale ($p<0.01$), and higher on the overall well-being scale ($p<0.001$).

Wilbur et al. [8] investigated the associations among physical activity and vasomotor, nervous, and general health symptoms in a group of healthy midlife women who were participating in a bone density study (n=361). The nervous symptom assessment included self-reports of tiredness, irritability, headaches, depression, nervous tension, and difficulty sleeping. Among the general health symptoms measured were joint and back pains, cough, sore throat, dizziness, upset stomach, and others. The physical activity assessment included the self-reported estimates of time spent in occupational, leisure, and household activities. The women's ages ranged from 34-62 years with a mean of 47 years, and were classified as either premenopausal (n=171), perimenopausal (n=62), postmenopausal without HRT (n=100), or having had a hysterectomy (n=32).

As would be expected, premenopausal women had fewer vasomotor and general health symptoms compared to the other three groups. Statistical significance was reported only for the vasomotor variable. For the combined sample of women, estimates of occupational energy expenditure were positively related with both nervous and general health symptoms, while leisure energy expenditure was negatively related to these symptoms. Aerobic fitness was negatively related to general health symptoms; however, significance was not achieved for the associations between fitness and either vasomotor or nervous symptoms. This was likely due to the fact that in these analyses, the participants were treated as a single group, potentially confounding the measurement of the effects (if any) of fitness on perimenopausal or menopause-related symptoms. The effects of physical activity and fitness on vasomotor, nervous, and general health measures in the perimenopausal and menopausal groups were not reported. These authors concluded that leisure-related physical activity, and not occupational physical activity, is associated with fewer mood and health complaints among women in midlife. This research did not provide evidence that the overall level of physical activity reduced the experience of vasomotor symptoms.

Part of the difficulty with this study, and many other studies investigating the benefits of physical activity, is related to the measurement of physical activity. In particular, the instruments that accurately capture exercise participation rates in men may not be valid for women in midlife. This is because of their emphasis on sport participation in the measurement of leisure-time activity. The physical activity patterns of women are less likely to be dominated by sport, and more likely to include household and garden activity, childcare activities, and walking. The study by Wilbur et al. [8] was notable in that it used self-reports of time spent in each of occupational, leisure, and household domains of physical activity. In some of the studies cited here [1, 15, 8], measurement of physical fitness was included along with self-reports of physical activity, and were both used as independent variables in analyses. None of the investigators revealed whether discrepancies between these two measures were evident.

In the most widely cited study in this field of research, Hammar and colleagues [10] compared the self-reported incidence and severity of hot flushes among postmenopausal women (aged 52 to 54 years) in a general population (n=634) with the reports of women of similar age and menopausal status who were members of a gymnastics club (n=142). Physical activity levels were not assessed for the general sample, though were reported for the club sample to range from between 1-10 hours per week (mean three hours/week). Those in the general sample reported moderate to severe hot flushes in the range of previously reported incidences (43.8%); whereas only 21.5% of the club members reported such symptoms. Within the club cohort, those women who had no hot flushes whatsoever reported spending 3.5 (± 1.8 hours) per week on physical exercise, while those who had moderate to severe hot flushes spent significantly fewer hours on exercise (2.6 ± 1.2 hours per week ; $p<.05$).

In a three-year prospective study, Owens and colleagues [14] followed 507 healthy premenopausal women, aged 42-50 years at baseline, to determine whether high levels of physical activity could protect against age-associated changes in biological risk factors. Psychological well-being was also measured using standard tests for depression and perceived stress. At the end of the three years, the subjects were divided into three groups according to how their physical activity had changed during the interval. Those who had increased their energy output by more than 300 kcal per week had significantly smaller increases in stress and depressive symptoms than those who either maintained the same levels of

physical activity or reduced their energy output over the three years. No specific data were reported for women who had experienced menopause during the study.

Two intervention studies by Slaven and Lee [1, 15] examined the effects of an acute exercise bout on self-reported symptoms including vasomotor, somatic and sleep problems in premenopausal, perimenopausal, and postmenopausal women (with and without HRT). General well-being and mood questionnaires were administered to 47 women of different menopausal status recruited from fitness centres. Participants completed these questionnaires immediately before, and again, immediately following a 45-minute aerobics class. The results indicated that the acute exercise bout had an effect on reported mood and menopause-related symptoms among these regular exercisers, independent of menopausal status. This suggested, as other studies have, that the ability to derive psychological benefit from exercise is not hampered by menopausal status.

Although physical activity appears to have a generally positive effect on physical and psychological health and well-being for menopausal women, a number of authors [6, 8, 13], have admitted that their samples were restricted to relatively well-off, educated women. As Guthrie and colleagues [13] suggested, their initial representative sample, which was randomly selected by telephone number, may have, as a result of sample size reduction, produced a bias towards higher education. This makes it more difficult to prove the benefits of physical activity in a cross-sectional study, because the distribution of physical activity levels is skewed, and the participants are generally healthier to begin with.

With respect to the limits of sampling, it is positive to note that Hammar and colleagues [10] focused exclusively on perimenopausal women and on vasomotor symptoms. Their physically active sample was a discrete group of women who were members of a gymnastics club. It was, however, unusual that no estimates of physical activity were collected from the control group, which was merely presumed to be less active. The apparent dose-response effect of exercise on symptoms within the physically active group lent some credibility to their findings that women in the general population were more likely to experience vasomotor symptoms than those in the gymnastics club.

D. Summary

The neurochemical mechanisms by which physical activity has been proposed to reduce the vasomotor symptoms of menopause and the psychological distresses of midlife are well-founded. However, uncertainty surrounding the true etiology of hot flushes, and confusion about whether other symptoms are linked to estrogen withdrawal, leave the role of physical activity in the attenuation of menopausal symptoms unknown.

The studies that have been conducted to date have tended to blend vasomotor symptoms of menopause with other, less well-accepted symptoms such as mood state, and somatic distresses. A number have also combined small samples of women from a range of hormonal states into multivariate analyses that are unable to reach significance because of the relatively few participants who experienced vasomotor symptoms, regardless of exercise participation. As well, the measurement of physical activity has been problematic due to the difficulties in capturing participation rates based on physical activity patterns for men, self-report techniques, and the difficulty assessing activities performed in the context of daily life.

The conclusions of the studies done to date are also limited by the lack of diversity in the samples of research participants. Most participants have been relatively well-off, educated, and therefore healthier women, which makes it more difficult to confirm the benefits of physical activity for the general population. The observational design of the available reports precludes any ability to assign causation in the relationship of exercise and the reduction of symptoms. It may have been the case in any, or all, of these studies that women who were experiencing more severe symptoms participated less often in physical activity than did those whose midlives had been less distressing.

It is evident from these works that hormonal and menopausal status does not affect the capacity of a physically active lifestyle or acute bouts of exercise to generate psychological benefits. However, the nature of its role on alleviating symptoms associated with the menopause remains to be elucidated.

E. Gaps in the Literature

As this research area is clearly in its infancy, the gaps are broad and readily identifiable. Unfortunately, they are most likely remedied by large and costly studies. For example, most of the studies conducted to date have been cross-sectional. No longitudinal investigations have followed large cohorts of physically active and sedentary women to assess the development (measuring both likelihood and severity) of menopausal symptoms in each. There have also been no intervention studies to investigate the effect of chronic exercise on symptoms of perimenopausal women. In fact, there have not been any studies to examine the dose-response relationship, and the time course of symptom reduction or mood change, associated with physical activity.

There are also some problems with the samples that have traditionally been used in studies investigating the relationship between physical activity and menopause symptoms. The use of self-selected exercisers and non-exercisers means variables such as expectations, motivation, attitudinal differences and previous health may influence results. No studies have randomly assigned participants to exercise and non-exercise groups. We also have an insufficient understanding of physical activity and its relationship to menopausal symptoms in a cultural context. Studies need to explore this relationship in societies in which symptoms are not experienced (or acknowledged) and those in which they are considered a medical issue.

Finally, the independent effects of estrogen withdrawal on somatic and psychological symptoms need to be better understood. Until the etiology of menopause has been adequately described, we will not have a clear picture of the relationship between physical activity and menopausal symptoms. From the research that has been conducted in this area to date, few conclusions can be drawn about the effects of physical activity on menopausal symptoms. The lack of consensus on exercise effects is not surprising, as there is no general agreement on which symptoms are uniquely associated with the menopausal transition.

However, the data presented here provide sufficient evidence to conclude that physical activity is associated with a greater sense of well-being and fewer psycho-somatic symptoms in women in midlife. These associations must be viewed with a certain amount of caution in that women who are physically active during this stage of their lives may have a different set of expectations and attitudes that are the basis for both their exercise behaviour and their higher scores on psychological tests. The need for prospective studies that include both interventions and observation is clear. Until such studies are complete, our understanding of the role of physical activity in the well-being of menopausal women will be based on extrapolations from studies conducted on other age groups and/or men.

F. Implications

1. Research recommendations

As menopause is the most readily identified event within a range of graduated physiological changes associated with aging in women, studies on the effect of physical activity on the menopause need to be longitudinal and continue for at least five years. This will enable researchers to measure the association of physical activity with known and previously unidentified characteristics of the climacteric. Such studies should include:

- prospective investigations on large cohorts of physically active and sedentary women to assess the development (measuring both likelihood and severity) of menopausal symptoms in each;
- intervention studies on the effect of chronic exercise on symptoms in perimenopausal women;
- examinations of the dose-response relationship and the time course of symptom reduction or mood change associated with physical activity;
- random assignment of participants to exercise and non-exercise groups in all intervention studies.

Not only does the independent physiological role of estrogen withdrawal in the development of somatic and psychological symptoms need further investigation, but the social and cultural context needs to be considered as well. Further studies need to explore the relationship of physical activity and menopausal symptoms in societies in which symptoms are not generally experienced (or acknowledged) and those in which they are considered a medical issue.

With respect to various exercise modalities, there is need to identify whether exercise (testing, timing and modality) can reduce the incidence or severity of insomnia associated with menopausal hot flushes, as well as what effects exercise has on body image and self-esteem of women in midlife.

Suggested research questions

1. What are the underlying mechanisms that explain the physiological role of estrogen withdrawal in the development of somatic and psychological symptoms such as tiredness, forgetfulness, irritability, nervousness, and loss of concentration?
2. What role does the social and cultural context play in the experience of menopausal symptoms by Canadian women?
3. What type, time and intensity of exercise is most beneficial for alleviating vasomotor symptoms of menopause such as insomnia and hot flushes?

2. Policy recommendations

It is perhaps too early to recommend the development of physical activity programs for the specific purpose of reducing menopausal symptoms. However, the benefits of exercise to mental well-being, as well as the bone and cardiovascular health of women in midlife, are clear. Physical activity programs designed specifically for women in this stage of their lives are warranted. Programmers must recognize that these women may hold negative associations with the notion of exercising, have less experience with contemporary forms of exercise such as aerobic dance, and bear multiple roles (job, household, caregiving children and/or older parents) due to their lifestage and generation. Opportunities for enjoyable physical activity must therefore present themselves within the context of these realities.

Health practitioners should be encouraged to strongly recommend physical activity to their patients, where appropriate, as an alternative to medication use, and guide them with specific ideas and resources. Health educators, and those who are in positions of influence with women, must initiate the diffusion process. Women in midlife need to feel confident that regular physical activity is an achievable and unselfish goal, one that is sanctioned by the health profession and society as a whole, and one that will be of benefit to their health and self-image.

G. Search Strategies

A comprehensive search of the medical (Medline) and psychological (Pychinfo) literature over the past 18 years revealed that very few published studies describe investigations into the effect of physical activity on the vasomotor and psychological changes that accompany menopause and midlife in women. Most of the reports identified by the key words of “menopause” and “physical activity” or “fitness” focused on the physiological benefits of exercise as it relates to bone loss and cardiovascular disease risk. Others were speculative papers proposing a role for physical activity and similar lifestyle changes (such as diet), in the amelioration of menopausal symptoms in order to reduce reliance on hormone replacement [5, 9, 12]. The authors of these discussions were able to cite only a few studies to support their hypotheses, and called for more research in this area.

The specific databases and years include:

- Medline 90-94; 95-98
- Psychinfo 1980-98

Specific search terms (key words) included all combinations of the following categories:

- menopause
- physical fitness, exercise, physical activity

H. Literature Summary Tables

The following tables organize the literature reviewed with respect to the relationship between menopausal symptoms and physical activity. Only those articles that investigate the relationship between physical activity and menopause specifically are included.

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Dennerstein, et al. [6]. Psychological well-being, midlife and the menopause.	• observational	• middle-aged (mean: 50 years) • women (n=1503)	• self-reported physical activity	• women who exercised minimum 1x/week scored better on psychological measures
Guthrie et al. [13]. Physical activity and the menopause experience: a cross-sectional study.	• observational	• middle-aged • women (n=555)	• self-reported physical activity	• level of physical activity was positively associated with better self-rated health • no association with vasomotor symptoms
Hammar et al. [10]. Does physical exercise influence the frequency of postmenopausal hot flushes?	• observational	• postmenopausal women • aged 52-54 years • members of gymnastics club (n=142) • general population (n=634)	• membership in gymnastics club • self-reported physical activity	• gymnastics sample reported significantly lower incidence of hot flashes • within-sample difference observed by activity level
Owens et al. [14]. Can physical activity mitigate the effects of aging in middle-aged women?	• longitudinal (3 year follow-up)	• healthy women pre-menopausal at baseline (n=507) • 42-50 years of age	• self-reported physical activity • estimate of weekly energy expenditure	• increases in physical activity associated with smaller increases in depressive symptoms
Slaven & Lee [1]. Psychological effects of exercise among adult women: the impact of menopausal status.	<u>Study 1</u> • observational cohort <u>Study 2</u> • intervention (no control)	• regular and non-exercisers • premenopausal (n=30) 37-52 years of age • postmenopausal without HRT (n=30) 40-65 years of age • regular exercisers • premenopausal (n=15) 30-52 years of age • postmenopausal without HRT (n=17) 39-72 years of age	• self-reported exercise frequency • walking fitness test • acute (50-min.) aerobic exercise session	• exercisers had more positive scores on mood dimensions than non-exercisers • no differences according to hormonal status • acute bout enhanced mood regardless of menopausal status

Reference	Study Design and/or Key Words	Study Sample	Physical Activity Key Words	Results/Conclusions
Slaven & Lee [15]. Mood and symptom reporting among middle-aged women: the relationship between menopausal status, hormone replacement therapy, and exercise participation.	<u>Study 1</u> • observational cohort <u>Study 2</u> • intervention (no control)	• premenopausal (n=93) • perimenopausal (n=32) • postmenopausal with HRT women (n=41) • postmenopausal without HRT (n=54) • regular exercisers • premenopausal (n=16) • postmenopausal with HRT(n=15) • postmenopausal without HRT women (n=16)	• self-reported exercise frequency • walking fitness test • acute (45-min.) aerobic exercise session	• across the groups, exercisers reported fewer symptoms than non-exercisers • no within-group differences • acute bout reduced symptoms, enhanced mood regardless of menopausal status
Wilbur et al. [8]. The relationship among menopausal status, menopausal symptoms, and physical activity in midlife women.	• observational cohort	• premenopausal (n=171) • perimenopausal (n=63) • postmenopausal without HRT (n=100) • women with hysterectomies (n=36) • 34-62 years of age	• self-reported occupational, leisure, and household activity • test of aerobic fitness	• fitness and energy expenditure were associated with fewer nervous and somatic symptoms but not vasomotor symptoms in middle-aged women

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IX. FIBROMYALGIA AND CHRONIC FATIGUE SYNDROME

Candice L. Schachter, PT, Ph.D. and Angela J. Busch, B.PT, M.Sc.

A. Chapter Overview

What do we know?

In general, the literature supports the incorporation of aerobic exercise for the management of fibromyalgia and chronic fatigue syndrome (CFS). Physical activity plays an important role in managing the discomfort and pain associated with both fibromyalgia and chronic fatigue syndrome, thereby contributing to an improved quality of life for those women who suffer from these chronic syndromes.

What do we need to research?

Most studies in the area of fibromyalgia and exercise do not reach scientific rigour. Improvements were inconsistent among studies and affected only some aspects of the syndrome. Also, interventions were primarily conducted and evaluated on a short-term basis. Finally, attrition plagued many studies on fibromyalgia and exercise and limited the findings.

The one study on chronic fatigue syndrome and exercise suggests that aerobic exercise may have a significant place in the management of the syndrome, but because of the dearth of research in this area, more research is warranted.

What should we do?

Due to the low levels of fitness and the special needs of most women who suffer from fibromyalgia and chronic fatigue syndrome, exercise programmers may wish to develop specific programs and strategies that consider these issues. As well, among exercise and health professionals there should also be a growing awareness of the prevalence and severity of these health issues. Well-researched education programs and exercise training protocols should be developed to ensure that the specific needs of women suffering from fibromyalgia and CFS are met.

B. Introduction

1. Fibromyalgia

Description of fibromyalgia

The 1990 American College of Rheumatology (ACR) diagnostic criteria for fibromyalgia consist of widespread pain for longer than three months and pain on palpation of at least 11 of 18 specified tender points on the body [1]. A 1996 consensus report offers a broader picture, describing fibromyalgia as a syndrome of widespread pain, decreased pain threshold, and characteristic symptoms, including non-restorative sleep, fatigue, stiffness, mood disturbance, irritable bowel syndrome, headache, paresthesias, and other less common features [2].

Etiology of fibromyalgia

Although many researchers have studied muscle tissue and function in fibromyalgia, only nonspecific changes have been found [3-8]. Researchers have explored several possible causes for fibromyalgia syndrome (FMS) including: muscle pathology [5, 9], muscular ischemia, [7], previous musculoskeletal trauma [10, 11], abnormal pain modulation [12, 13], sympathetic nervous system dysfunction [14] and deconditioning [15-17]. The etiology of fibromyalgia is still unknown.

Prevalence of fibromyalgia

The prevalence of fibromyalgia in women in the general public has been reported to range from 3.4% (across all ages) [18] to 10% in women aged 20-49 years [19]. The disorder accounts for 20% of the referrals in most rheumatology practices and 7% of general practices [20, 21]. Limitations in activities of daily living have been reported to be as high in fibromyalgia patients as in patients with rheumatoid arthritis [22]. The condition is chronic and non-remitting, and symptoms affect every aspect of life and cause a pronounced impact on work, family life and leisure [23; p. 40]. Researchers have reported on the alarming impact of fibromyalgia on work and productivity. For example, 20-50% of persons with FMS could work few or no days [24, 25], while 36% had an average of two or more absences from work per month [26]. In addition, 26.5-55% had received disability or social security payments [5, 26]

Exercise and fibromyalgia

Many individuals with fibromyalgia have been shown to be sedentary [27] and most (64-80%) have aerobic fitness levels well below average [27-30]. While the underlying pain, fatigue and depression are likely to contribute to sedentary lifestyles and therefore low levels of fitness, individuals with fibromyalgia are able to perform tests of maximal aerobic fitness and are capable of performing low and moderate intensity aerobic exercise training.

2. Chronic fatigue syndrome (CFS)

Description of chronic fatigue syndrome

Chronic fatigue syndrome has been described as a condition requiring the presence of major and minor criteria. Major criteria are: the onset of persisting or relapsing debilitating fatigue, in a person without a previous history of such symptoms, that does not resolve with bed rest and that is severe enough to significantly reduce daily activity for at least six months, and with fatigue that is not explained by the presence of other evident medical or psychiatric illness [31]. Minor criteria must include at least eight symptoms, or a lesser number of symptoms in combination with several signs (ranging from minor fever of chills to low-grade fever) [31]. The description of this syndrome continues to evolve.

Etiology of chronic fatigue syndrome

The medical cause of chronic fatigue syndrome has been linked to viral infection or immune dysfunction [32]. This syndrome has also been linked with depression [33] and to the interaction of cognitive, behavioural, physiological and social factors [34, 35]. Researchers continue to seek a definitive cause of chronic fatigue syndrome.

Prevalence of chronic fatigue syndrome

Variations in the estimation of the prevalence of chronic fatigue syndrome exist [31]. It should be noted that there is significant overlap of symptoms in individuals with chronic fatigue syndrome and fibromyalgia.

Exercise and chronic fatigue syndrome

Some studies have shown individuals to be capable of performing tests of maximal aerobic capacity, and have shown individuals with chronic fatigue syndrome to have low levels of fitness [36, 37]. Other researchers have found difficulty achieving maximal levels of performance with individuals with CFS [38]. It is unclear as to whether whole body aerobic capacity of individuals with chronic fatigue syndrome is physiologically abnormal, or whether limitations are due to fatigue, pain or motivation. Individuals appear to be capable of performing low and moderate intensity aerobic exercise [39].

C. Literature Review

The studies considered for inclusion in this review were required to meet four criteria before being selected. Each of the selected studies: a) makes use of published diagnostic criteria, b) makes use of an experimental design, c) ensures the majority of research subjects in the study are women, and d) ensures that at least one intervention includes a significant exercise component. The studies were then evaluated according to the strength of their findings with the assumption that the large randomized controlled trials (with low false-positive and low false-negative errors), are more reliable than the smaller randomized controlled trials (with high false-positive and/or high false-negative errors).

Nine articles were found that could be classified as experimental. Eight articles dealt with fibromyalgia and one article dealt with chronic fatigue syndrome. Of the studies examining fibromyalgia and exercise, four studies employed randomized controlled designs (in which a non-treatment control group was used); four additional studies employed randomized comparison designs in which two or more treatments were compared without the use of a non-treatment control group. For the purposes of this review, studies using a randomized comparison group design have been included with those using a randomized control design, a methodology advocated by Piper [40], Boyd and colleagues [41], and Megens and Harris [42]. The one study evaluating chronic fatigue syndrome and exercise employed a randomized comparison design.

Study characteristics are summarized in Table 1 and Table 2. Of the eight studies on the effects of exercise in fibromyalgia, three studies were classified at a higher level of reliability, [43-45], and five were categorised as less conclusive [38, 46-49]. The one study on the effects of exercise in chronic fatigue syndrome was classified at a higher level of reliability [39].

1. Fibromyalgia

Subject inclusion and exclusion criteria

All studies used published criteria for the diagnosis of fibromyalgia. All classification systems used are well described in the literature and although some differences exist, for the purposed of this review, all were considered to be acceptable and roughly comparable. In two studies [43, 47] all subjects were female, while in three additional studies [45, 46, 48] fewer than 10.5% of the subjects were males. In the remaining studies [44, 49], the authors did not provide information on the gender mix of the sample. Exclusion criteria were variable (e.g.,, abnormal blood tests, cardiovascular, pulmonary, renal and rheumatic diseases). Only one study [48] excluded individuals based on recent previous participation in regular physical activity.

Repeatability of the treatment protocol

The mode of aerobic exercise training used in the studies was quite familiar and practical, and included supervised training using a stationary bicycle [44], aerobic dance [47], fast-paced walking [46, 48], and aerobic games [45, 49]. Aerobic exercise was done in groups with 2-3 sessions per week for six weeks [46], eight weeks [48], 14 weeks [45] or 20 weeks [44, 47]. One study [43] compared education to education plus aerobic exercise that was primarily home-based. The exercise was self-selected (walking, swimming or cycling) and was done at home five sessions per week for 12 weeks. Most studies used heart rate as a method of determining level of intensity.

While the description of the aerobic exercise component of most studies was adequate to allow for replication, four studies that included a flexibility and strengthening component provided insufficient information to allow repetition of that particular treatment or component of treatment. Two studies compared the effects of aerobic training to another form of exercise. Flexibility manoeuvres [44] and steady exercise (composed of body awareness, balance, motor control and stretching) [49] were not described in enough detail for replication. Martin and colleagues [46] combined aerobic training with stretching and muscle strengthening; while the aerobic component was sufficiently described, the

stretching and strengthening lacked sufficient detail for replication. Information on the exercise routines was lacking in an investigation of the effects of amitriptyline and light muscle stretching, amitriptyline and strenuous exercise, and strenuous exercise alone [38]. Lastly, in a study comparing the effects of an education program, a combined exercise and education program, and no treatment [43], the exercise component was inadequately described.

Outcome measure reliability/validity

There is no consensus regarding the preferred outcome measures for fibromyalgia research [2]. In an analytical review of controlled clinical trials for fibromyalgia, White and Harth [50] recommended the use of the following instruments in fibromyalgia: Visual Analogue Scales (VAS) (pain, sleep, fatigue); global assessments; pain pressure threshold (dolorimetry); Fibromyalgia Impact Questionnaire; and the Arthritis Impact Measurement Scales 2. These measures, with the exception of the latter, were common in this literature. In addition, several other measures were used in these studies, and most were reliable and valid.

While significant effects were reported, these effects were not found consistently. For example, significant improvement was observed in Pain-VAS in one study [45] but not found in three others [44, 46, 47]. Pain diagrams showed improvement in one study [45] but not in another [44]. Fatigue-VAS was improved in one study [45] but not in another [48]. Pain threshold was improved in three studies [38, 44, 45].

Cardiovascular endurance was measured using a variety of test procedures and significant improvement was found in three studies [44-46] but not in three other studies [43, 47; 51]

Other significant improvements were reported sporadically including Active Tender Point Count and Total Myalgic Score [46], self-perceived change [44, 45], physician-perceived change [44], upper extremity muscular endurance [47], subjective rating of well-being [47], and psychological distress [48]. In one [48] a significant worsening was observed in physical disability using the Sickness Impact Profile. Overall, however, the results suggested that the effects of aerobic exercise training on fibromyalgia were favourable.

Blind assessment

In most cases, objective tests were applied by observers who were blind to group assignment.

Account for attrition

Drop out rates in excess of 20% plagued several studies [45-49]. This left the researchers in each instance with poor power and thus a large possibility for type 2 errors. Although the sample attrition was accounted for, and in some cases statistically adjusted for, validity problems associated with small sample sizes could not be avoided.

2. Chronic fatigue syndrome

One study categorized as a randomized comparison trial [39] was evaluated.

Subject inclusion and exclusion criteria

Based on the Oxford criteria for chronic fatigue syndrome [52], 74% of the research subjects in the Fulcher and White [39] study were women. The exclusion criteria included: current psychiatric disorder other than simple comorbid phobias and symptomatic insomnia.

Repeatability of the treatment protocol

The interventions were either an aerobic exercise program or a flexibility program. Both activities were carried out five days per week for 12 weeks. The aerobic exercise treatment was reproducible and involved a home-based walking program that was progressed from 5-15 minutes per day at low intensity, to 30 minutes per day at a moderate intensity. Further information about the flexibility treatment (similar duration and frequency) would be required to repeat the protocol.

Outcome measure reliability and validity

The primary outcome measure was a Self-Rated Clinical Global Change scale. Secondary measures included depression, anxiety and fatigue scales, SF-36, physiological measures derived from a maximal test of aerobic capacity (VO_{2peak}, Ve_{max}, submaximal heart rate and rate of perceived exertion (RPE)), submaximal and post-test blood lactate, and maximal voluntary contraction of the quadriceps muscle. Measures appeared to be both valid and reliable.

Results demonstrated greater improvements in self-rated clinical global change, physical fatigue, total fatigue, total SF-36 and SF-36 physical function, VO_{2peak}, Ve_{max}, submaximal heart rate, and RPE with aerobic exercise than with flexibility exercise. These results support the effectiveness of aerobic exercise in the treatment of CFS.

Blind assessment

Evaluation of physical performance, while not blinded, was standardized. The observer participating in measurement of other outcome measures was blinded to group assignment.

Account for attrition

The authors accounted for all subjects enrolled in the study.

D. Summary

In general, this review supports the incorporation of aerobic exercise for the management of fibromyalgia and chronic fatigue syndrome. With respect to fibromyalgia, several recommendations can be made regarding the use of exercise for the management of this chronic syndrome, based on the findings of the large randomized controlled trials reviewed here. These recommendations include:

- the use of supervised aerobic cycle ergometry (a progression to 1 hour/session x 3 times/week x 20 weeks) at a heart rate greater than 150 beats/minute can improve aerobic fitness, total myalgic score, and global self- and MD-rated scores [44].
- the use of education, or education and partially supervised, partially home-based exercise, can improve quality of life and self-efficacy in women with fibromyalgia [43].
- aerobic exercise (45 minutes/session, 3 times/week x 14 weeks) can result in significant improvements in pain, tender points and aerobic fitness [45].

Although the results of the smaller trials are less conclusive, several recommendations with respect to the use of exercise to manage fibromyalgia can be made based on these findings as well. These recommendations include:

- the use of a combination of 15 weeks of amitriptyline and a progressive aerobic exercise program, or progressive aerobic exercise alone, may improve pain threshold and tolerance in selected sites more than amitriptyline alone. The combination of medication and exercise tends to be more effective than exercise alone.

- tender points and total myalgic scores improve more with an exercise program of aerobic exercise, stretching and strengthening (6 weeks, 1 hour/session, 3 times/week) than with a relaxation program of similar frequency and duration [46].

With respect to chronic fatigue syndrome, the single study reviewed here suggests that aerobic exercise such as the program studied by Fulcher & White [39] may enhance management of this syndrome.

Although the findings for both fibromyalgia and chronic fatigue syndrome show a generally positive relationship between increased exercise and improved management of each syndrome, this statement can be made only with qualifications in that a) most studies did not fulfill all criteria used for the evaluation of scientific rigour (Table 3) and b) there are inconsistencies in findings of improvements in symptoms of fibromyalgia, and improvements are not found in every aspect of the conditions.

E. Gaps in the Literature

Review of studies of fibromyalgia and exercise yields support for the use of aerobic exercise in the management of fibromyalgia and chronic fatigue syndrome. Cautionary notes further to the qualification listed above in the summary must be made. The studies examined in this review have, for the most part, examined short-term effects of supervised or semi-supervised exercise interventions. One study [43] found some improvements when evaluated on a longer term (four to eight months after post-test, including control group subjects who had crossed over to an experimental intervention). A four-year follow up [45] found that subjects in the initial exercise group were, by and large, not still exercising, and also reported a reduced tenderness only in the stress-reduction group compared to the control group. Further studies on the long-term effects of exercise on these conditions are needed, as are further examinations of home-based exercise, physical activity, and subject attrition. These suggestions are not new in research about the effects of exercise and physical activity and health in general. They are important issues to address and perhaps represent a next step in the examination of exercise and these chronic conditions.

Attrition plagued many studies on fibromyalgia and exercise and limited the findings. While studies accounted for subject attrition, the attrition rates illustrate problems that have not been fully addressed in this body of research. Current literature on research design recommend that studies which attempt to evaluate the impact of interventions delivered in a program format ought to include not only data of study participants who adhered with the intervention but individuals with lower levels of adherence, including those who withdrew from the study. One such approach being advocated for this purpose is the intent to treat analysis. Few studies used this approach in their research, and further studies employing this technique are recommended. In studying those who drop out of exercise studies, researchers may identify a sub-population that does not gain the same benefits or has particular problems with adherence to exercise.

The one study on chronic fatigue syndrome and exercise suggests that aerobic exercise may have a significant place in the management of the syndrome. Limitations include the exclusion of possible subjects with comorbid psychiatric disorders (44% of the potential population) and the absence of additional studies. Results of a one-year follow-up (that included subjects who had crossed over from the flexibility group to the aerobic exercise group) showed a significant number of subjects rated themselves as improved.

F. Implications

1. Research recommendations

Based on the findings of the studies included in this review, it is clear that the use of large randomized controlled trials must continue in research on fibromyalgia and chronic fatigue syndrome. The results of these trials would also be significantly enhanced through the use of long-term studies that consider both the effects of exercise over time, as well as the adherence of research subjects to an exercise program.

Due to the significant problem of attrition in studies in the area of fibromyalgia and chronic fatigue, researchers should also develop a strategy to address this concern and follow up with subjects who drop out, possibly by using intent to treat analyses. It may also be useful for researchers to consider the effect of physical activity on those research subjects who suffer from fibromyalgia or chronic fatigue syndrome but who were excluded from the present studies due to comorbid psychological disorders. And finally, research in this area would be greatly enhanced by examination of methods of program delivery, extending beyond the traditional supervised, or partially supervised, exercise program.

Suggested research questions

1. What role does physical activity play in the prevention of fibromyalgia and/or CFS?
2. How do initial levels of physical fitness and physical activity interact with exercise training to affect women with fibromyalgia and CFS?
3. What are the determinants of exercise and physical activity for women with fibromyalgia and CFS?
4. What are the long-term effects (1+ years) of exercise and physical activity programs for individuals with fibromyalgia and CFS?
5. What types of exercise are beneficial for individuals with fibromyalgia and/or CFS (considering flexibility and muscle strengthening in addition to aerobic exercise)?
6. Are there subpopulations of women with fibromyalgia and CFS whose conditions are aggravated by increased levels of exercise/physical activity?
7. What methods of program delivery facilitate increases in levels of exercise and physical activity in women with fibromyalgia and/or CFS?
8. Are the Canadian Guidelines for Healthy Active Living effective in facilitating increased levels of exercise, physical activity and physical fitness in individuals with fibromyalgia and/or CFS?
9. Do women with fibromyalgia and CFS accrue long-term health benefits normally associated with increased levels of physical activity (such as decreased incidence of coronary heart disease)?

2. Policy recommendations

It is clear that physical activity plays an important role in managing the discomfort and pain associated with both fibromyalgia and chronic fatigue syndrome, and thereby contributes to an improved quality of life for those women who suffer from these chronic syndromes. However, the variability of the condition and the special characteristics (pain, fatigue and low level of fitness) of most of these women means that approaches to starting and maintaining an exercise or physical activity program may be affected. Programmers may wish to develop specific strategies and programs that consider these issues. Because of the high prevalence rates and wide impact of fibromyalgia and chronic fatigue on Canadian women, additional resources may be required for health care providers and exercise/physical activity programmers to collaborate with researchers on an ongoing basis. This collaboration may facilitate short- and long-term adherence and provide ongoing evaluation and modification of programs.

G. Search Strategies

For this review, the literature search was restricted to English publications from 1966-1998. The following databases were searched:

- Medline
- CINAHL
- HealthSTAR

These databases were searched using primary thesaurus terms and all topical associated subheadings for: fibromyalgia, fatigue -syndrome - chronic

- exercise, exertion, therapeutic-exercise and physical therapy

This was followed up by word searches for:

- fibromyalgia, fibrositis, chronic fatigue syndrome
- aerobic, exercise, fitness, therapeutic exercise, strengthening, flexibility

Reference lists of articles were then reviewed and any potential sources followed up. Reports for all experimental studies were selected and critiqued with particular attention to methodology and results.

H. Literature Summary Tables

Table 1 - Summary of Study Characteristics

FIBROMYALGIA

Reference a) study b) study type c) duration (weeks)	Inclusion/Exclusion Criteria	Study Sample a) gender ratio (women:men) b) N	Pain	Ftg	Sleep	Dpt	TP	FIQ	Aerobic	Str	Psych
a) McCain et al. [44] BOTH: 60', 3x/wk, x 20 wk CV EX: supervised bicycle, HR>150, duration progressed FLEX: flexibility manoeuvres, HR<115 b) R Comp c) 20 wk	Inclusion: dx: (Smythe), successful stress test Exclusion: a) amitriptyline within previous 3 months, b) hx ischemic heart disease, symptomatic cardiac arrythmias, c) ex induced asthma	mixed, gender info not given N=42 CV EX=18 Flex=20 DO=4/42 =9.5%	ns R V		ns R? V?	+ R? V?	+ TM S R V		+ R V		ns R V?
a) Mengshoel et al. [47] EX: 60 min., 2x/wk, x 20 wk Aerobic dance, HR 120 - 150 CG: no change in habits b) RCT c) 20 wk	Inclusion: dx: (ACR), some weekly activity Exclusion: abnormal blood test	all women N=25 EG=11 CG= 14 DO=10/25 =40%	ns R V	ns R V	ns R? V?	+ R? V?			ns R V	+ R? V?	ns R V
a) Isomeri et al. [38] ALL: 3 wk in Hosp, 12 wk at home A: Light muscle stretching plus amitriptyline 25 mg/evening B: progressive strenuous physical training C: progressive strenuous physical training plus amitriptyline 25 mg/evening b) R Comp c) 15 wk	Inclusion: dx: Yunus and Wolfe Exclusion: Unable to participate in strenuous physical training due to medical reasons or medication	A: 13 : 3 B: 12 : 3 C: 14 : 0 N=51 A = 16 B = 15 C = 14 DO= 6/51 = 11.8%	ns R V				C>A R V				

Reference a) study b) study type c) duration (weeks)	Inclusion/Exclusion Criteria	Study Sample a) gender ratio (women:men) b) N	Pain	Ftg	Sleep	QoL	TP	FIQ	Aerobic	Str	Psych
a) Nichols & Glenn [48] Walk: WP, 20', 3 x/wk x 8wk, fast-paced walk, 60-70% Predicted Max HR CG: untreated b) RCT c) 8 wk	Inclusion: dx: (ACR), sedentary Exclusion: a) heart, lung, uncontrolled hypertension, orthostatic hypotension disorder, b) regular physical activity in the previous 6 mo.	CG 8:1 EG 9:1 N=24 EG=10 CG=9 DO=5/24 = 20.8%	ns R V					- SIP R V?			+ BSI R V?
a) Burckhardt et al. [43] CG: untreated, offered trt at 12 wk ED: 6 wkly 1hr grp self management EX: ED plus 6 sessions: exercise counselling, relaxation, pool home program b) RCT c) 6 + 6 unsupervised wk	Inclusion: dx: (ACR), understand Swedish Exclusion: a) Abnormal lab (Hb, free thyroxine, ESR, ANA, RF, CK), b) other rheumatic disease	all women N=99 1:CG=30 2:Ed=31 3:Ed/Ex=28 DO=13/99 =13%	SELF: f:3* p:3* o:3* FAI: 2*, 3* R V			QofL 1<2+3 R V	ns 2* R V	ns 2* R V	ns R? V?	ns R V?	ns R V
a) Wigers et al. [45] AE 45', 3x/wk, whole body ex, aerobic games (30hrs) SMT 90', 2xwk x 6 w, 90' 1x/wk x 6wk Cognitive-behavioral, stress management, relax, coping (30hrs) TAU Treatment as usual b) RCT c) 14 wk	Inclusion: dx: (combined: Smythe/ Yunus Exclusion: none	55:5 N=60 1:AE=16 2:SMT=15 3:TAU=17 DO=12/60 = 20%	+ R V	ns R V	ns R? V	+ 1>3 R V	+ 1>3 R V		+ 1>2, 1>3 ? ? 		ns V A S 2>3 R V

Reference a) study b) study type c) duration (weeks)	Inclusion/Exclusion Criteria	Study Sample a) gender ratio (women:men) b) N	Pain	Ftg	Sleep	Qlt	TP	FIQ	Aerobic	Str	Psych
a) Martin et al. [46] EX: 60', 3/wk x 6 wk, WU + 20' sup'd walk, 60-80% HR max, 20' flex/str (UE, LE, trunk) Relax: 1 hr, 3/wk x 6 wk (visualization, yoga, autogenic relaxation) b) R Comp c) 6 wk	Inclusion: dx: (ACR) Exclusion: a) CV, pulmonary, neurological or renal disease, b) medications that physiological response to ex	58:2 N=60 1:EX=18 2:Relax= 20 DO=22/60 = 36.7%	ns VA S R V	SELF: ns IIQ: ns R,V R , V?			ns 1* R V	ns R V	ns 1* R V	ns R? V?	
a) Norregaardet al. [49] AE: 50', 3/wk x 12 wk (10'WU,40' free standing, fast mvts, running), target=40-50% VO_{2max} EX: 50', 2/wk x 12 wk (10'WU,40' body awareness, balance, motor control, stretching), steady speed HP: 30' 2/wk x 12 wk (whole body hot packs) b) R Comp c) 12 wk	Inclusion: dx: (ACR), age:20-70 Exclusion: a) pregnancy or lactation, b) alcoholism, c) CV, lung, renal or rheumatic disease, d) anticoagulant medication.	unknown - gender not given N=38 1:AE:n=5 2:EX:n=11 3:HPs:n=7 DO=15/38 = 39.5%	ns V A S R V	ns V A S R V	ns V A S R? V?		ns R V	ns R V	ns R? V?	ns R? V?	

CHRONIC FATIGUE SYNDROME

Key to abbreviations anx=anxiety depr=depression ftg=fatigue sleep ?pt= perceived change str=strength phys fun=physical function

Reference **a) study** **b) study type** **c) duration (weeks)**	**Inclusion/Exclusion Criteria**	**Study Sample** **a) gender ratio (women:men)** **b) N**	**anx**	**depr**	**ftg**	**sleep**	**?pt**	**Aerobic**	**str**	**phys fun**
a) Fulcher & White [39] BOTH: exercised @lab 1/wk, @home 5/wk x 12wk AE: walking, cycling, swim 15' @40% VO_{2peak}, increased 1-2'/wk to 30', then progressing to 60%VO_{2peak} F/R: flexibility, relaxation, starting at 10' progressing to 30', 5/wk b) R Comp c) 12 wk	Inclusion: dx: CFS,Oxford criteria, 1991 Exclusion: current psychiatric disorder, symptomatic insomnia (<u>note:</u> comorbid simple phobias not excluded)	49:17 N=66 1:AE:n=29 2:F/R:n=30 DO:7/66 =10.6%	ns R V	ns R V	+ R V	ns R V	+ R V	+ (Maximal) + partial (Smax) R V	ns R V	+ R V

Key to abbreviations:

+=statistical significance
?minute
cv=cardiovascular
dx=diagnosis
ex=exercise
ftg=fatigue
HR=heart rate
hx=history
psych=psychological variables
?pt=perceived change
ns=no statistical significance
QofL=quality of life
R=reliable
R?=questionable reliability
RCT=randomized controlled trial
R Comp=randomized comparison trial
Smax=submaximal
Str=muscle strength, endurance
TP=tender points
tms=total myalgic score
V=valid
V?=questionable validity
*= within group difference (pre to post)

Table 2 - Summary of Study Characteristics Dependent Variable List for Fibromyalgia Studies

Key:
y = measured shaded y = statistically significant improvement lined y = statistically significant decrease

Dependent Variable	Instrument	Study (see key below)							
		1	2	3	4	5	6	7	8
Pain	VAS	y	y	y			y	y	
	Pain Diagram	y					y		
	McGill Pain Questionnaire				y				
Fatigue	VAS		y				y		
Sleep	Quantity: nights per wk, hours per night	y							
	Quality: unreferenced questionnaire	y							
	Quality: VAS		y				y		
Tender Points	Pain Threshold: Dolorimetry	y		y			y		
	TP Count					y		y	y
	Total Myalgic Score					y		y	
Impact of FMS	Fibromyalgia Impact Questionnaire					y		y	y
Self-Efficacy	Self-Efficacy Scale (pain,function,other) Sense of Control over Disease					y		y	
Clinical Improvement	Self-Perceived Change	y					y		
	MD-Perceived Change	y							
Cardiovascular Fitness	2 staged bicycle ergometer test (PWC 170)	y							
	Steady state bicycle ergometer test		y						
	6-minute walk test					y			
	Treadmill - Modified Balke							y	
	Staged Bicycle Test						y		y
Flexibility	Sit Reach Test					y		y	
Muscle Strength	Knee, Shoulder (Cybex)							y	
	Knee/ Elbow Isokinetic Muscle Strength (LIDO)								y

Dependent Variable	Instrument	Study (see key below)							
Static Muscle Endurance	# of max voluntary contractions							y	
Upper limb Endurance	Vigorometer (grip strength rep 1-20)		y						
Lower limb Endurance	Stair Step Test		y						
	Reps Up - down from chair					y			
Feeling of well-being	Subjective Rating		y						
Coping	Vanderbilt Pain Coping		y						
Disability	Sickness Impact Profile				y				
Psychological Distress	Symptom Checklist (SCL-90-R), Brief Symptom Inventory	y			y				
Depression	Beck Depression Scale					y			y
	VAS						y		
Quality of Life	Quality of Life Scale					y			
	Illness Intrusiveness Questionnaire							y	

Key:

1 = McCain et al 1988 2 = Mengshoel et al 1992 3 = Isomoeri et al, 1993 4 = Nichols & Glenn 1994
5 = Burckhardt et al 1994 6 = Wigers et al 1995 7 = Martin et al 1996 8 = Norregaard et al 1997

Table 3 - Summary of Scientific Rigour of Studies

Author	Study Type	Defined FMS	Treatment can be repeated	Reliable outcome measures	Valid outcome measures	Blind assessment of outcomes	Account for attrition
McCain et al. [44]	R Comp	Y	P	P	P	Y	Y
Mengshoel et al. [47]	RCT	Y	Y	P	P	Y	Y
Isomeri et al. [38]	R Comp	Y	N	Y	Y	?	Y
Nichols & Glenn [48]	RCT	Y	Y	Y	P	Y	Y

Author	Study Type	Defined FMS	Treatment can be repeated	Reliable outcome measures	Valid outcome measures	Blind assessment of outcomes	Account for attrition
Burckhardt et al. [43]	RCT	Y	P	P	P	Y	Y
Wigers et al, 1995	RCT	Y	Y	P	P	Y	Y
Martin et al. [46]	R Comp	Y	P	P	P	Y	Y
Norregaard et al. [49]	R Comp	Y	N	P	P	Y	Y

CHRONIC FATIGUE SYNDROME

Author	Study Type	Defined CFS	Treatment can be repeated	Reliable outcome measures	Valid outcome measures	Blind assessment of outcomes	Account for attrition
Fulcher & White [39]	R Comp	Y	Y	Y	Y	P	Y

Key:

RCT=randomized controlled trial
R Comp=randomized comparison trial
P=partial

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IMPLICATIONS: FUTURE RESEARCH, PROGRAM AND POLICY DEVELOPMENT

Colleen Reid, M.A. & Lesley Dyck, M.A.

Physical activity plays a critical role in the development and support of health and well-being for women and girls. Although in itself it is not sufficient for maintaining good health or preventing disease, it is a necessary component of high-level wellness and enhanced quality of life. This literature review attempted to make a contribution towards an understanding of the complexity of this relationship between physical activity, inactivity, health and well-being in the context of women's lives. It is our hope that The Health Benefits of Physical Activity for Girls and Women has provided a starting point that will enable researchers, programmers and policy makers to prioritize their research and interventions to make effective and efficient use of limited resources in support of the health of girls and women in Canada.

Although this review was intentionally limited to the health concerns identified by the researchers and community advisors as among the most important in the lives of Canadian women, it was also limited by the lack of interdisciplinary research to investigate the relationship between physical activity and health. The challenge of making links between bodies of knowledge that are often considered to be independent may be viewed as the second important contribution of this report. It is our intention that researchers in a variety of disciplines will be challenged to see the possibilities and promises of interdisciplinary research to contribute to our knowledge of some of the most prevalent health issues facing women and girls today.

What follows is a summary of the key recommendations for enhancing our understanding of the relationship between physical activity and health status, supporting increased participation in physical activity, and enhancing health and quality of life through physical activity for girls and women. It is important to recognize that this literature review has concentrated on the research papers that address the general relationship between physical activity and various health concerns, rather than on specific policy or program interventions designed to influence participation in physical activity as a health enhancement strategy. As a result, the recommendations that consider the more basic research issues related to the relationship between physical activity and health outcomes are the most comprehensive. The recommendations that make reference to policy or program initiatives must be considered only as a starting point. Regardless, the following recommendations cut across the various disciplines and research methods that have been applied to understanding the relationship between physical activity, inactivity, health and well-being. As a result, they underscore the importance of making the links between physical activity, health, well-being and the various research disciplines.

A. Key Recommendations

1. In order to enhance our understanding of the contribution physical activity makes to the promotion of health and well-being, and to the prevention, management, and rehabilitation of disease, we must:

- Support the development of large-scale, longitudinal, prospective studies that reproduce the most promising studies completed to date across a diversity of disciplines. In many cases, this strategy would be enhanced by randomized, case-control research methods.

- Provide additional support for multi-dimensional and interdisciplinary research that considers the interdependent nature of the relationship between physical activity and health, and utilizes both quantitative and qualitative research methods as appropriate. This approach would help to ensure the consideration of interactions (e.g., mind and body, gender-specific hormones), as well as contextual factors (e.g., social, cultural, environmental) that are specific to the lives of girls and women.

- Develop standardized measures (e.g., physical activity, health outcomes, body silhouette scales) and sound theoretical constructs (e.g., self-esteem, well-being, hormone-blood pressure relationship) to

provide a foundation for understanding underlying mechanisms and establishing appropriate comparisons. This would help to break down some of barriers between the various disciplines and create links between biological theory (e.g., etiology of disease), behavioural theory (e.g., self-efficacy, stages of change), and social theory (e.g., human agency, empowerment, community capacity).

- Consider diversity with respect to gender, with more studies based specifically on girls and women. Socioeconomic status is a determinant of both health and participation in physical activity, and needs to be considered in future research, especially with respect to women with lower income and education levels. There is also a need for research to consider marginalized populations within the dominant culture, such as lesbians, older adults and younger girls, visible minorities and those women from minority cultural backgrounds, and women and girls who are living with a disability.

- Include the context in any assessment of the relationship between physical activity, health and well-being. Research has clearly demonstrated that the physical activity performed in the context of daily life or in the workplace is often quantitatively and/or qualitatively different from that performed as recreation or leisure, often as a result of environmental, cultural, and social factors.

- Evaluate "real world" interventions and consider both positive and negative outcomes. For example, research has demonstrated that exercise interventions may provide some unexpected well-being benefits even among those smokers who fail to quit during a smoking cessation intervention.

2. In order to support greater participation of girls and women in physical activity, policy makers and program developers must:

- Provide increased opportunities for girls and women to participate in physical activity throughout the life cycle. This will require programs that are easy to implement and are appropriate to life stage within the social, cultural and environmental context.

- Ensure that programs are tailored to specific populations and that the accessibility be evaluated according to the quality as well as the quantity of opportunities. The program design must also ensure that the type, duration and intensity of the exercise is appropriate for the target population in order to ensure safety and support adherence. Programs should also be targeted to women who are at risk for specific diseases (e.g., estrogen-related cancers, cardiovascular disease, osteoporosis) and other health-related problems such as falls among older women.

- Ensure that experiences of physical activity are positive, regardless of location (e.g., school, playground, fitness centres, community), and that they emphasize cooperative activities and the development of life-long physical competency.

3. In order to support the use of physical activity for the enhancement of health, well-being and quality of life for girls and women, researchers, policy makers and practitioners must:

- Develop community partnerships and interdisciplinary relationships that address the contribution of physical activity to the interdependent and holistic nature of health and well-being. Only by acknowledging the interrelationship of the cultural standards of female beauty, the diminished power of women within a male-dominated society, physical self-efficacy, eating disorders and diseases such as osteoporosis, cardiovascular disease, and estrogen-related cancers, can we expect to make significant steps in preventing illness and promoting well-being.

- Promote ethical standards in the media, and fitness programming and marketing, that reject female beauty ideals based on excessive thinness, the promotion of over-exercise, and the promotion of false claims about weight loss.

- Educate professionals in the areas of fitness, health, media, and education (universities and schools) about the dangers associated with many current practices in the areas of beauty, fitness and weight loss. Practitioners should be supported to develop and implement programs that focus on developing self-confidence, self-esteem and well-being.

B. Political Implications

It has been estimated that between one-quarter and one-third of health care services in British Columbia are ineffective [1]. If these ineffective services could be identified and eliminated, funds could be made available for health services that do improve health, or for cost-effective initiatives in other sectors such as childcare, early childhood education, housing, income support, or physical activity. If just a fraction of any money saved through greater health care efficiencies were put toward the key recommendations outlined in this report, the health of girls and women would be significantly supported. Similarly, budgets from other ministries could be invested in physical activity with similar payoffs [2; p. 9].

A recent report from the Heart Health Coalition [2] in British Columbia, provides a comprehensive and up-to-date rationale for putting physical activity at the top of the public agenda. While not specific to the health issues of women and girls, this discussion paper makes a number of policy recommendations with respect to health and physical activity that bear consideration. For example, this report recommends that public policy:

- Formally acknowledge the crucial role physical activity can play in improving women's health and controlling health care costs, and commit to a plan of action.

- Designate the Ministry of Health and Ministry Responsible for Seniors as the lead ministry to coordinate all government efforts in the area of physical activity.

- Designate the Ministry of Education, Skills and Training as the government leader for necessary changes in the school setting.

- Designate the Ministry of Small Business, Tourism and Culture as the government leader for the necessary changes in the community setting.

- Ensure that the Ministry for Children and Families is a critical player in increasing physical activity in young people.

- Call together potential partners, without delay, to establish roles and responsibilities, develop plans, and commit to a community-based strategy to reach the Provincial Health Officer's goals for physical activity.

Additionally, the work of the Ministry of Women's Equality focuses on social and economic factors that contribute to women's health, including employment, safety, working conditions, income, social status and education. The Ministry's advocacy role includes working in partnership with the Ministry of Health's Women's Health Bureau and other ministries to ensure that women's concerns are reflected in services and programs, and that the health care system is respectful of and responsive to women's needs. Although the British Columbia government supports a range of programs and services to address women's health care needs [3], very little has been done to acknowledge the health benefits of physical activity for girls and women. In light of the overall findings of this literature review and the key recommendations, it is clear that the Ministry of Women's Equality and the Women's Health Bureau are well-positioned to enhance the social, psychological and physical health of women through the support of physical activity. By ensuring improved accessibility, sensitive programming, and increased collaboration among professionals and organizations, these ministries could support increase participation in physical activity for girls and women in B.C. In turn, health care system costs would decrease by reducing unnecessary hospitalizations, visits to the doctor, drug use, and sick days resulting from preventable sickness or disorder caused by physical inactivity [4; p. 4].

C. Next Steps

Although this review makes a strong argument for the support of physical activity to enhance the health and well-being of girls and women, there is a significant need for a comprehensive review to establish what programs and policies are currently in place, how they are working, and how researchers, practitioners and policy makers can work collaboratively to ensure that opportunities for physical activity are available and accessible to all women.

As a next step in the policy analysis and the dissemination of these research results, it is important to identify key audiences who would find this document useful and could use the findings to support and enhance their own practice. The key audiences that have been identified include:

The sport, recreation, and physical activity field
- Programmers and policy makers at the municipal, provincial and federal levels
- On The Move program
- More Than An Open Door program
- Promotion Plus (B.C. Sport organization)
- The Canadian and the Vancouver YWCA
- The Canadian Association for the Advancement of Women in Sport (CAAWS)

The public health field
- Programmers, practitioners, and policy makers at the municipal, provincial, and federal levels

The women's health field
- Local women's centres
- The B.C. Centre of Excellence for Women's Health
- The B.C. Women's Health Bureau
- The B.C. Ministry of Women's Equality

The education system
- Primary, secondary, and post-secondary institutions (universities, university-colleges)

The social service system
- Dissemination at different levels of service delivery

The health, physical activity, medical, nursing, and other health- and lifestyle-related research communities
- Academic researchers
- Community-based researchers

Health, social science, science, and humanities research funding agencies
- Social Sciences and Humanities Research Council (SSHRC)
- Canadian Institute for Advanced Research (CIAR)
- Canadian Institute for Health Research (CIHR)
- Canadian Fitness and Leisure Research Institute (CFLRI)
- Health Canada
- The B.C. Health Research Foundation (BCHRF)

The general public
- Diverse populations of girls and women
- The media

Further research is required so that this report can be disseminated appropriately to the different audiences who are interested in the relationship between health and physical activity among girls and

women. Continued research would provide an overview of the programs and policies that are currently in place and the appropriate people and/or organizations to address with specific policy recommendations. For instance, in British Columbia there are programs and organizations that are currently addressing the physical activity needs of girls and women. Examples include (this is by no means an exhaustive list):

- The B.C. Centre of Excellence for Women's Health (BCCEWH)
- The Canadian Association for the Advancement of Women in Sport (CAAWS)
- The Vancouver YWCA
- Promotion Plus (B.C. Sport)
- The B.C. Recreation and Parks Association (BCRPA)
- The Vancouver Boys and Girls Club
- The Canadian Heart and Stroke Foundation
- St. Paul's Hospital Eating Disorders Clinic
- Osteofit program – B.C. Women's Hospital
- On the Move Program

D. Some Final Thoughts

We now have a good understanding of determinants of physical activity with respect to women and girls [5], and we would argue that this literature review provides a strong foundation for understanding the benefits and risks of physical activity for the health and well-being of girls and women. In the quest to understand the relationship between physical activity and health, only an examination of the policies and programs that impact the participation of girls and women in physical activity remains to be completed in order to support the promotion of health and well-being of girls and women.

This review of the literature contributes to the foundation for developing further research projects and strategies for linking research, policy, and community development based on the relationship between physical activity and health. We now need to answer some of the most important and complex questions in order to support health and well-being through physical activity:

- How and why do individual and social factors such as age, lifecycle, ethnicity, sexual orientation, employment, socioeconomic status, family type and privilege influence physical activity levels and choices made by women and girls?

- How does the experience of physical activity in the context of everyday life influence the type and amount of activity women engage in? What strategies do women use to incorporate physical activity in their lives?

- What is the impact of community programs and policies that are designed to encourage women and girls to be physically active?

In facing the challenge to make the links between physical activity and the health, and between the diversity of academic disciplines and research methods, we are well on our way to answering these questions and promoting the health and well-being of girls and women in our society.

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Vancouver, C.-B.
CANADA

Les avantages pour la santé de l'activité physique chez les filles et les femmes

Analyse documentaire et recommandations pour de futures recherches et politiques

Ce rapport de recherche sur la santé des femmes est offert en français et sous des formes utilisables par les personnes handicapées. Pour plus de détails, veuillez communiquer avec le Centre d'excellence de la C.-B. pour la santé des femmes

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