Psychosocial Variables Related to Why Women are Less Active than Men and Related Health Implications

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Supplementary Issue: Health Disparities in Women

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ABSTRACT: This article reviews psychosocial influences on women's participation in physical activity as they differ from men and how associated activity differences impact women's risk for a number of chronic diseases. This topic directly aligns with the mission of this special edition related to disparities in women's health as the typically lower level of physical activity in females directly impacts their health. On average, females participate in physical activity at lower rates than their male counterparts. These lower rates of physical activity are directly related to both incidence of and outcomes from cardiovascular disease, type 2 diabetes, and breast and gynecological cancers. The relationship between psychosocial factors that are understood to affect physical activity differs between men and women. Specifically, self-efficacy, social support, and motivation are empirically substantiated factors that found to impact physical activity participation among women differently than men. Understanding these relationships is integral to designing effective interventions to target physical activity participation in women so that the related health risks are adequately addressed.

KEYWORDS: physical activity, women's health, determinants of physical activity, self-efficacy, social support, motivation

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Introduction

The United States Surgeon General recommends that adults perform at least 150 minutes/week of moderate-intensity exercise or 75 minutes/week of vigorous-intensity exercise to achieve the health benefits associated with an active lifestyle.[1] When examining the objectively measured physical activity of a nationally representative sample, less than 5% of adults meet the recommended 30 minutes/day on most days of the week.[2] Even more concerning is the fact that from as early as preschool and young childhood, females fall behind their male counterparts in minutes per day of physical activity,[3–6] possibly due to factors such as greater participation in physically active after-school activities among boys.[7] This trend of lower physical activity among women continues throughout adulthood,[2] with women consistently getting less moderate- and vigorous-physical activity than their male counterparts. These lower rates of physical activity have far-reaching effects on women's health, with cardiovascular disease and cancer being the first and second most common causes of mortality, respectively, among females of all ages.[8,9] Similarly, risk for type 2 diabetes, the seventh leading cause of death among women, has been overwhelmingly linked to the rates of physical activity.[8,10] Understanding the real-world implications of lower rates of physical activity for women is an important first step in furthering the discussion around the importance of evidence-based interventions to improve the physical activity participation rates.

With considerable evidence supporting the sex differences in physical activity levels across the lifespan, researchers have turned their focus to better understand the mechanisms that might be triggering or supporting these discrepancies. Specifically, calls have been made to identify key psychological and social variables that are likely related to physical activity to determine whether sex differences exist among these dimensions that help explain the discrepancies in reported physical activity and exercise behavior.[11] Several theoretical models have been proposed to guide research in this area. For example, self-efficacy theory,[12,13] theory of planned behavior,[14] and self-determination theory[15] have provided useful underpinnings for literature focused on psychological correlates of physical activity behaviors.

The purpose of this review was to summarize the current understanding of the health-related implications of lower rates of participation in physical activity affecting women across the lifespan as a means of arguing for the importance of greater attention among the research to why this discrepancy persists. This review then focuses on recent research examining the related psychosocial variables that have been reliably connected to physical activity participation and how these factors differ between men and women, both as a call to

further research and so practitioners can better understand the variables at play in regards to physical activity participation of their patients and clients.

Methods

The process of literature review was conducted in two parts, given the distinct nature of the focal content and tendency for these topics to be reported in differing publication outlets. First, multiple brief reviews of the recent literature in regard to the relationship between physical activity and exercise and three of the major contemporary issues in women's health (cardiovascular disease, type 2 diabetes, and breast and gynecological cancers) were conducted. These searches were intended to represent the current literature that provides context to the argument for the development of a stronger understanding of the psychosocial variables at play. However, it is acknowledged that the searches are not exhaustive, given the breadth of literature in each of these areas. Search databases used were Medline and SPORTDiscus, and search terms used were *women, physical activity, exercise, cardiovascular disease, heart disease, type 2 diabetes, cancer, breast cancer, ovarian cancer, endometrial cancer*, and *cervical cancer*.

A second, comprehensive search of published studies was conducted to investigate the psychosocial variables that present sex differences, as they relate to their relationship to physical activities and exercise behaviors. Initial searches on the research databases Scopus, PsychINFO, and SPORTDiscus identified self-efficacy, social support, and motivation as broad, foundational psychosocial variables studied with these relationships in mind. Therefore, subsequent searches utilized combinations of the following key terms: *self-efficacy, social support, motivation, gender differences, sex differences, physical activity,* and *exercise*. The literature collected utilized both the gender and sex terms, where it was apparent that gender was referring to biological sex as opposed to self-referenced gender identity, the term gender was converted to sex in the writing of this review for consistency. Table 1 includes this search information with the additional constraints listed in the following paragraph.

Table 1. Summary of comprehensive search for psychosocial variables.

Potentially relevant articles identified through searches in Scopus, PsychINFO, and SPORTDiscus as well as reference list reviews	1,708
Articles excluded based on review of titles and abstracts (duplicates removed) with full set of inclusion criteria considered	1,647
Full text articles reviewed	61
Articles excluded for not fully addressing all three variables of interest (ie, focal psychosocial variable, physical activity and/or exercise, and gender differences explored)	39
Articles included in review	29

Both searches were further constrained by the following inclusion criteria: (a) recent research (ie, published between 2005 and 2015); (b) participant populations from North America or those regions with similar cultural and fiscal norms to North America (eg, Europe and Australia); and (c) publication in English. This second search involving psychosocial variables was also constrained to the original research/empirical studies and research that considered all three variables of interest (ie, a psychosocial concept, physical activity/exercise, and sex/gender) in a single study. Titles and abstracts of the search results were reviewed for relevance to the relationships of interest, and references within these articles were reviewed for additional support. All included articles met the ethical requirements of their original institutions. All papers adhered to the standard of defining statistical significance at an alpha level of <0.05.

Health Implications of Physical Activity Participation Among Women

The lower rates of participation in physical activity among women have far-reaching effects on women's health. Both exercise and physical activity are significantly related to all-cause and cardiovascular disease-related mortality among women,[16–18] independent of adiposity,[19] resulting in a longer life expectancy among more active adults.[20] Similarly, higher levels of physical fitness, which are highly related to physical activity levels among older adults,[21] are also strongly related to mortality among women.[22] Women whose exercise capacity is less than 85% of their age-predicted values have more than twice the mortality rate as women who exceed this threshold.[22] Although definitions vary slightly, moderate-physical activity can be defined as activity with "noticeably accelerates the heart rate" (eg, brisk walking) and vigorous-physical activity "causes rapid breathing and a substantial increase in heart rate" (eg, jogging).[23] These operationalizations are utilized throughout the remainder of the review.

Risk for and prognosis after diagnosis from the two most common causes of mortality, cardiovascular disease and cancer, among women are both strongly linked to physical activity participation.[24–29] Among other chronic diseases that have been clearly established to be related to physical activity levels, type 2 diabetes is the next most common cause of mortality.[9,10] Additionally, type 2 diabetes is a major cause of both cardiovascular disease and stroke[30] and is linked to increased risk of breast cancer.[31]

Recent evidence regarding the relationship between physical activity and three major health concerns—cardiovascular disease, type 2 diabetes, and breast and gynecological cancers—are briefly reviewed later. However, it should be noted that in addition to the effects on cardiovascular disease, type 2 diabetes, and breast and gynecological cancer rates and prognosis, physical activity also impacts a wide variety of health-related issues and outcomes among women, including depression,[32] sleep quality,[33] likelihood of onset disability,[34]

and others. For the purpose of this article, review was limited to these three major health concerns for women, each of which represents an area of extensive research.

Cardiovascular disease. In population-based, cross-sectional and longitudinal studies, increased participation in physical activity has been consistently shown to be linked with lower rates of cardiovascular disease in women,[16,35,36] associated cardiovascular risk factors,[37–39] and mortality from cardiovascular disease.[17,40] Although some studies indicate that a person must reach moderate-to-high levels of activity to incur these benefits,[41] others find benefit at even light levels of activity for healthy subjects,[38] even among those with clustered metabolic abnormalities.[42] Of interest is emerging research examining the clustering of physical activity and sleep behaviors, which appear to have effects on the risk of cardiovascular disease.[43,44] A large (>1 million women) prospective cohort from the United Kingdom indicated that moderately active women had lower rates of vascular disease, but that over 2–3 days/week of strenuous activity did not confer any additional benefits and may actually be associated with increased risk.[45] Some of the positive effects of physical activity on cardiovascular disease may be attributable to the impact of physical activity on known risk factors, including inflammatory and hemostatic factors and blood pressure.[36,38,46]

Prospective exercise trials begin to shed some light on not only the volume of physical activity required on a weekly basis to incur benefits but also the duration for which a person must be active to achieve these benefits. A community-based walking program, with a predominantly female, minority cohort, demonstrated that an increase of an average of 2,000 steps per day (approximately 1 mile) resulted in improvements in systolic blood pressure, fasting blood glucose, total cholesterol, waist circumference, and body mass index in as little as eight weeks.[47] Among healthy, but overweight or obese women, six months of moderate-intensity aerobic training elicited improvement among heart rate variability measures,[48] but not C-reactive protein.[49] Heart rate variability serves as a good indicator of autonomic nervous system balance and has been linked to an increased risk of cardiovascular disease.[50] Similarly, C-reactive protein, a marker of inflammation, has been linked to cardiovascular disease in women.[51] Among older adults, 10 months of aerobic training was adequate to reduce an array of inflammatory markers.[52] In women with type 2 diabetes, a 12-week supervised exercise intervention of 5 days per week was sufficient to improve endothelial function.[53] Similarly, a yearlong lifestyle intervention for patients with type 2 diabetes designed to increase physical activity and promote weight loss resulted in an improvement in risk factors for cardiovascular disease as well as improved diabetes control.[54] Among coronary artery disease patients, 12 weeks of aerobic training improved cardiovascular risk, including a reduction of several pro-inflammatory markers, including C-reactive protein.[55] Therefore, it appears that particularly for women with worse initial cardiovascular health, benefits from physical activity may be incurred after just a few months of activity.

For a comprehensive review on the research on physical activity and cardiovascular disease in women specifically, see Oguma et al;[24] for a review on the literature involving men and women, see Nocon et al.[25] In summary, physical activity has beneficial effects for both prevention and treatment of cardiovascular disease, with even modest improvements in daily exercise demonstrating benefits.[38,45,47] The recommendations from the American Heart Association and the American College of Sports Medicine are for all healthy adults to achieve 150 minutes/week of moderate-intensity exercise.[23] Similarly, recommendations for cardiac rehabilitation following a cardiovascular event include encouraging patients to accumulate 150–300 minutes of moderate-intensity physical activity across most days of the week.[56]

Type 2 diabetes. There is also a consistent link between moderate- and vigorous-intensity physical activity participation and rates of type 2 diabetes among women,[57–61] that is independent or only partially mediated by the effect of adiposity.[10,57,58,60] Additionally, studies show a link between increased light physical activity and reduced sedentary time, independent of participation in moderate- and vigorous-physical activity, and improved glycemic control variables.[61–63] However, a recent review indicates that advising patients to increase physical activity alone is not adequate to improve HbA1c, but 150 minutes/week of structured activity is sufficient.[64] There is a strong evidence that the improvement of type 2 diabetes with exercise and physical activity is largely due to improved insulin action, blood glucose control, and improved fat oxidation and storage within the muscle.[65]

Women with a family history of type 2 diabetes may actually respond better to relatively short exercise interventions (seven weeks) than women without a family history,[66] possibly due to worse baseline insulin sensitivity. However, Klimentidis et al found that physical activity was more protective among those with lower genetic risk scores for type 2 diabetes,[67] indicating the need for greater study in this area. Similarly, among individuals with impaired fasting glucose, increasing leisure-time physical activity reduced incident diabetes rates over 4.1 average years of follow-up, an effect that remained significant after adjusting for changes in diet and body weight.[68]

Among women who had type 2 diabetes, a 12-week exercise intervention was sufficient to improve the HbA1c levels.[53] However, acute bouts of physical activity were not sufficient to improve performance on a glucose challenge the following day in women with type 2 diabetes,[69] indicating the need to adopt physical activity for at least several weeks. Among middle-aged men and women with type 2 diabetes, each 1,000 additional steps per day was associated with a slower progression of arterial stiffness.[70] Similarly, over four years of follow-up, greater levels of moderate-to-vigorous physical activity (≥3 METs) and reduced sedentary time among men

and women with type 2 diabetes was associated with improved kidney function.[71] Identifying means to help type 2 diabetics achieve recommended levels of physical activity requires additional investigation. An examination of physician records of over 6,800 patients with type 2 diabetes undergoing the normal standard of care indicated that only 16% will begin to attain the recommended 150 minutes/week following diagnosis of type 2 diabetes and that women were less likely to achieve these recommended physical activity levels.[72]

Aune et al conducted a recent meta-analysis demonstrating an inverse relationship between physical activity and type 2 diabetes, up to approximately 5–7 hours/week of physical activity.[10] For a thorough review on the quality of evidence in regards to the mechanisms by which exercise and physical activity reduce the risk of diabetes, see the American College of Sport Medicine and American Diabetes' Association Joint Position Stand, which encourages the individuals with type 2 diabetes to obtain a minimum of 150 minutes/week of moderate-intensity exercise.[65] Additionally, for exercise practitioners, the guidelines from the ADA regarding exercise prescription for patients with type 2 diabetes and its associated long-term complications may be useful.[73] In summary, even moderate levels of physical activity are effective in reducing the risk of and improving prognosis after the diagnosis of type 2 diabetes.[57,58,65]

Cancers. There is an strong evidence that for cancers that largely or solely impact women, physical activity is a factor in prevention, including breast,[26,27,74,75] endometrial,[29] and ovarian[28,76] cancers. However, the data for cervical cancer prevention are sparse and poorly controlled for known associations.[77] When examining the six cancers with the strongest evidence of a link between physical activity and prevention (colon, breast, endometrial, ovarian, lung, and prostate), a review by Friedenreich et al[77] estimated that between 9% and 19% of these cancers in Europe could be prevented if Europeans maintained recommendations of 150 minutes/week of moderate-intensity physical activity or 60 minutes/week of vigorous-intensity physical activity. Across cancer-types, evidence suggests that physical activity may impact the risk of cancer through improved body composition, insulin resistance, and sex hormone levels, including increased sex hormone-binding globulin and decreased estrone and estradiol.[77,78] Among survivors of all types of cancer, physical activity is associated with reduced all-cause mortality[79] and increased upper and lower body strength and reduced fatigue.[80]

The positive effects of physical activity on breast cancer are the most established findings, although some research indicates that the positive effects of physical activity on the prevention of breast cancer may be greatest in or limited to postmenopausal diagnosis.[81–84] Research indicates that while moderate-intensity activity does help reduce the risk of breast cancer, greater benefits can be achieved with regular vigorous-intensity physical activity[27] with little difference across estrogen receptor status.[85] Additionally, while lifetime physical activity infers the greatest benefit for prevention of breast cancer, a postmenopausal increase in physical activity among low-active women does incur benefits.[26] Similarly, physical activity reduces risk across all strata of body mass index levels.[86] Recent reviews found that the majority of studies claim that risk reduction attributable to physical activity was between 25% and 30%,[87] and each additional hour of physical activity was associated with a 6% decrease in risk of breast cancer.[82] While the currently available literature regarding cancer prevention largely focuses on breast cancer, reviews indicate that there is sufficient evidence to suggest that physical activity participation significantly reduces the risk endometrial[88,89] and ovarian[90] cancer as well.

The data regarding the relationship between physical activity and prognosis after cancer diagnosis is also largely focused on breast cancer, with no studies on physical activity and prognosis specifically for endometrial, ovarian, or cervical cancer.[91] For breast cancer, physical activity in both the year prior to diagnosis[74,92,93] and following diagnosis[93–96] is positively related to lower mortality, from both breast cancer- and non-breast cancer-related causes, especially cardiovascular disease.[97] Of these, Holmes et al[95] found that benefits appear to be stronger at higher levels (equivalent to three to five hours of walking per week) of activity. However, the ideal duration, frequency, and type of physical activity have not been well defined.[98] Improved mortality may be due to improvements in insulin sensitivity, inflammation, and immune function.[79] In addition to improving mortality, a review by McNeely et al[99] suggests that exercise leads to improved quality of life, physical function, and peak oxygen consumption, as well as reduced fatigue among breast cancer survivors. Along these lines, Backman et al demonstrated that participants in a physical activity intervention reported a positive impact on their perceived health, physical, and mental well-being, despite the increasing symptom burden as their treatment for breast cancer continued.[100] Improvements in measures such as self-reported health, pain, anxiety, and depression may come at even relatively low levels of physical activity (60 minutes or more per week),[101] However, the beneficial effects of physical activity on quality of life may not be significant among women with advanced breast cancer.[102] It is worth mentioning, however, that Carmichael et al[98] pointed out the majority of currently available data regarding physical activity and breast cancer diagnosis are on White, professional women from Europe and North America.

In short, the evidence for a link between physical activity levels and cancer prevention and prognosis among breast and gynecological cancers is strongest for breast cancer, especially postmenopausal[81–84] and earlier stages cancers.[102] Although there appears to be dose–response relationship between physical activity and both prevention[82] and prognosis,[95] ideal levels have not been defined. The American Cancer Society recommends cancer survivors work to achieve the standard recommendations of 150 minutes/week of moderate-intensity physical activity.[103]

Sex Differences in Psychosocial Factors and Influences on Physical Activity

Psychosocial correlates of physical activity are plentiful and include (but are not limited to) self-efficacy, perceived competency, outcome expectancies, attitudes, perceived barriers and risks, subjective norms, social support, motivation, enjoyment, decisional balance, and body image.[104–107] An evaluation of recent literature focusing on potential sex differences in these variables as they relate to physical activity identified self-efficacy, social support, and motivation as those constructs most researched with this three-component question in mind. Although the following review focuses on these areas of study, it should be noted that other psychosocial variables are likely at play but warrant more attention to establish sound empirical support for their impact.

Self-efficacy. Self-efficacy, defined as beliefs about one's abilities to successfully achieve a desired behavior,[12,108] has been identified as a core component of behavior adoption and maintenance. With greater levels of efficacy, individuals are more likely to self-regulate, put forth effort, and persist in the face of adversity when engaging in new and/or challenging tasks. Self-efficacy has also been established as a leading psychological influence on physical activity behavior, specifically.[11] The question, then, becomes do levels of self-efficacy differ among males and females in the physical activity domain, and do these differences correlate with the activity behavior? To this end, Spence et al investigated whether sex mediated the relationship between self-efficacy and physical activity in a large sample of Canadian seventh through tenth graders.[109] Adolescents provided self-report data on a variety of health behaviors, physical activity level, self-efficacy, and general demographic information. Results from hierarchical linear modeling established that sex did indeed moderate the relationship between self-efficacy and physical activity, with the relationships being more salient for females. However, with higher reported levels of self-efficacy, males were also found to be engaging in greater levels of physical activity than their female peers. Drawing upon self-efficacy theory[13] and related literature, it was suggested that this relationship might exist due to females encountering fewer mastery experience opportunities, greater risks for associated injuries, and less support for physical activity engagement. Similar relationships (ie, reduced risk of lower levels of reported physical activity being associated with both the male sex and higher levels of self-efficacy, although not in a single statistical analysis) have been substantiated among groups such as Belgian elementary aged children,[110] Polish adolescents,[111] and American college-aged students.[112]

Inchley et al conducted a similar investigation with a sample of 641 Scottish adolescents (aged 11–15 years).[113] Taking a longitudinal approach, results indicated that physical activity decreased for all adolescents over the five-year period, with males reporting greater physical activity than females at each time point. Additionally, the proportion of males reporting high levels of self-efficacy remained stable, while female levels on all self-perception variables (ie, self-efficacy, self-esteem, perceived competence, and physical self-worth) declined with time—most markedly during the transition from primary to secondary school. It was also during this transition time when a significant difference in self-efficacy between the two sexes was established. Implications for the timing of this shift in self-perceptions and pubertal development should be noted.

These sex-based distinctions in self-efficacy and physical activity appear to persist into adulthood. Looking at domain-specific efficacy, Pauline[114] found exercise self-efficacy and physical activity distinctions for sex in a sample of college-aged students, although the temporal widening of the gap between males and females had plateaued at this age. Specifically, males reported higher levels of moderate to vigorous physical activity as well as higher levels of exercise coping and scheduling efficacy (ie, belief in one's ability to plan for and remain active in the face of internal and external barriers and obstacles). While sex differences did not reach statistical significance in a similar study conducted by Nehl et al,[115] exercise self-efficacy was significantly and positively related to physical activity levels for both sexes, and male college students' scores for each variable trended higher than their female counterparts. Additionally, among samples of healthy older adults and those diagnosed with type 2 diabetes, similar and significant physical activity and self-efficacy relationships among the two sexes have been reported.[116–119] For example, men ($\bar{x}$ age = 64.2) and women ($\bar{x}$ age = 61.6) diagnosed with type 2 diabetes differed on levels of leisure time physical activity as well as physical activity efficacy related to coping with weather and time constraints, with males reporting higher levels of each.[120] Interestingly, these same sex differences in the relationship between physical activity and barrier-specific efficacy appear to be present in children as well.[121,122]

In summary, it appears that there is a compelling relationship between being male, having higher levels of self-efficacy, and engaging in greater levels of physical activity throughout the lifespan. Continued work in the area would benefit from more thorough investigations into barrier-specific efficacy differences between the sexes as well as identifying which efficacy-related activity promotion strategies (eg, vicarious experiences, verbal persuasion, mastery experiences) may be more prevalently addressed for males, leading them to engage in greater levels of activity.

Social support. Another cited correlate of physical activity and sex is social support, or the exchange of resources perceived to be intended for the enhanced well-being of the recipient.[123] With greater quantities and diversity in support types, which range from emotional, informational, and logistical support from family, peers, and health professionals (ie, support sources), an individual is more capable of adopting and maintaining behavior such as physical activity (which is also reflected in greater behavior-related efficacy beliefs). These relationships have been substantiated in the physical

activity domain and have also shown marked sex differences (see Wendel-Vos et al for a review).[124]

Much of the recent research has focused on youth and the influence of social support source types on physical activity and exercise. In one study of adolescents (aged 12–14 years), self-reported and objectively measured physical activity was assessed in relation to boys' and girls' reported social support.[125] Across all measures of activity, males exhibited more moderate to vigorous physical activity than their female counterparts. Additionally, males reported greater perceived family and friend support. When looking specifically at objectively measured afterschool and weekend physical activity of adolescent British 12–16-year olds, Edwardson et al[126] found boys spent significantly more time in weekend moderate to vigorous physical activity than girls (with after-school activity trending in this direction). Sex differences also existed in perceived social support, with males reporting more peer support. Sex-specific correlations also revealed a significant positive relationship between peer support and boys' afterschool moderate to vigorous physical activity and sibling support with girls' afterschool activity. Altogether, sex, age, and peer support accounted for 33 percent of the variance in afterschool moderate to vigorous physical activity. In a follow-up study with a larger and more ethnically inclusive sample of adolescents (11–14 years), Edwardson et al[127] found that boys reported more father explicit modeling, mother logistic support, father logistic support, and peer support than girls. Again, similar results have been found in even younger populations.[110,121,128]

Taking a longitudinal approach, Kirby et al[129] looked at the social support, sex, and physical activity relationships in a sample of Scottish adolescents (aged 11–15 years). These researchers found physical activity decreased every assessment year, with boys reporting more physical activity at each assessment. Additionally, peer support declined over all assessed years and parental support declining in the later secondary school years (with a greater and earlier decline perceived by girls in both cases). A cross-sectional study of American middle school children that also looked at age differences in physical activity and social support provides additional detail for how this relationship might progress over time.[130] Specifically, a decrease in physical activity with time (across ages 11–14 years) was observed for both sexes, although greater physical activity was reported by boys in all age groups. Students who were more likely to receive social support from their fathers were more likely to report greater physical activity minutes and a stronger physical activity self-definition or identity. Not surprisingly, boys reported greater paternal support than girls at all ages.

Unfortunately, recent literature looking at the relationships between physical activity, social support, and sex in a single statistical analysis that includes both male and female adults is nearly non-existent. An exception is a 2006 study of 373 men and women aged 17–77 years that found no predictive power of social support for physical activity among the two sexes.[131] However, the influence of such a large age-range in the sample should be questioned and more empirical support is needed before this finding can be generalized. On the other hand, there is a small handful of studies that have substantiated reports of sex differences in physical activity-related social support, with the trend seen in younger individuals persisting into adulthood[11] and men and women reporting access to different types of support.[132]

In combination, these result point to the possibility that males tend to report greater levels of support across many of the available support sources and that certain sources of social support might be more impactful in facilitating physical activity and exercise behaviors. However, more empirical research in this area is needed before conclusive relationships can be assumed, a greater focus on adult samples is warranted, and a look at the differing influences of social support types would help to further illustrate potential facilitators of physical activity for females who are engaging in lower physical activity levels at all ages.

Motivation. Surprisingly, a core driving force of human behavior, motivation (ie, behavioral direction and intensity),[133] is something that has not received a great deal of attention in the physical activity and sex differences literature.[114] However, a look at the extant literature demonstrates that differences in motivation for physical activity and exercise do exist between the sexes, pointing to a possible determinant of behavioral patterns in this context. In the study of college-aged students, Pauline uncovered significant sex main effects for physical activity reported as well as exercise motivation.[114] Again, males were more likely to engage in moderate- to vigorous-physical activity. Additionally, males were significantly more likely to report challenge, social recognition, affiliation, competition, health pressures, and strength as exercise motives, whereas females were more motivated by stress management, positive health, weight management, appearance, and nimbleness factors. Similar sex and motivation patterns were identified in another sample of college students, with males citing strength, competition, and challenge motives more than females, and females reporting higher levels of weight management and appearance motives than males.[134] Furthermore, a qualitative examination of exercise motives of English adolescents also uncovered relatively parallel sex discrepancies.[135] Specifically, males' introjected regulation, a form of extrinsic motivation, was primarily driven by factors such as ego-enhancement, fitting in, and avoiding social disapproval from peers. Females, on the other hand, were more likely to report external pressures to exercise for health and wellness as primary motives.

In a younger sample of 1163 adolescents aged 13–16 years, a series of analyses revealed sex distinctions in physical activity and motives for (ie, attractions to) the physical activity.[136] Supporting previous research, a decline in activity duration and energy expended was reported with increased age in the female sample. Additionally, females were more likely to report being

active for the outcome of improving one's body image, with the salience of this motive also increasing with age. Males, on the other hand, were more likely to report being attracted to physical activity for the fun of games, sports, and physical exertion and had higher levels of reported moderate- to vigorous-physical activity than their female counterparts. In an international sample of adolescents from the United States, Eastern Europe, and Western Europe, girls also reported less physical activity than boys and were less likely to report social and achievement motivations for physical activity.[137] Females, on the other hand, were more likely to cite health motives for their physical activity participation.

Across these studies of youth, it appears that the sex divides in physical activity and related motives tend to reflect more of an ego-oriented and performance focus for males (who are accruing more physical activity) and a health, well-being, and weight focus for the females studied. Interestingly, a recent project documented an even greater divide between the two sexes in the college-aged population in terms of the strength of exercise motives, with male students reporting significantly higher scores on 12 of 14 motivation variables surveyed, demonstrating almost a universally greater drive for physical activity than their female counterparts.[138]

Again, less attention has been paid to how motivation, sex, and physical activity interact in adulthood, but one exception is a study that explored the variables in parents of young children.[139] In their study of 458 Australian mothers and fathers of at least one child under the age of 5 years, the researchers substantiated the mediating effect of attitudes, subjective norms, and perceived behavioral control (components of the Theory of Planned Behavior;[14]) between one's self-determined motivation and PA behavior. While path modeling revealed several relationships that were similar between the two sexes (eg, attitudes mediating the indirect path from self-determined motivation to intention and planning mediating the indirect path from intention to behavior), an interesting distinction was that the path from motivation to perceived behavioral control was significant for males, but not for females. This distinction highlights the possibility that fathers are more likely than mothers to perceive that future physical activity participation is a controllable and self-regulated choice, drawing attention to the impact societal expectations for prioritizing the caretaking of their children over their own self-care are often placed more on mothers than fathers.[140,141]

Conclusion

Given the known health benefits of physical activity, it is imperative that interventions and programs designed to increase physical activity among females (who are, on average, less likely to be physically active than their male counterparts) take into account the gender-specific psychosocial factors and conditions that may influence a woman's decision to become and remain active. Although current intervention studies in women alone have found some success in addressing these psychosocial variables and impacting physical activity levels,[142–145] continued research is needed to understand how men and women respond differently to interventions that address these variables to fully delineate the best approach for the two sexes in order to avoid overgeneralizing strategies or adopting a cookie-cutter approach to physical activity promotion. Specifically, more research is needed that incorporates sex, physical activity, and psychosocial variables into single statistical analyses to verify some of the information currently deduced from studies of men and women in isolation or physical activity and exercise separate from sex differences in psychosocial variable levels and/or preferences. Also lacking is a critical mass of literature that explores sex differences in the impacts of other variables known to be associated with physical activity behaviors (eg, attitudes, perceived barriers and risks, enjoyment, body image). Additionally, the literature would benefit from additional research that utilizes a comprehensive theory to explore how the many psychosocial variables at play interact to influence physical activity and exercise differently among men and women. Finally, more attention needs to be paid to how physical activity is assessed across all studies. Many of the investigations included only one or two questions as an assessment of physical activity. Correspondingly, among validated questionnaires, criterion-related validity averaged only 0.25–0.41, although reliability was notably better (averaging 0.62–0.76).[146]

What we can gather from the current literature is that, more often than not, males and females demonstrate differing levels of physical activity and these differences put girls and women at unique risks for serious health consequences. Additionally, when activity levels differ between the sexes, we also tend to see differing psychosocial variable profiles. Males tend to report higher levels of physical activity, exercise, and exercise barrier self-efficacy, so interventions with females would benefit from components that specifically address these self-perceptions and provide strategies that align with Bandura's self-efficacy theory.[12,13] It should also be acknowledged that females do not perceive they have as diverse a network of support from significant others for their physical activity behaviors when compared to their male counterparts. Intervention efforts would benefit from strategies to help girls, and women recognize the support they may already have at their disposal and/or solicit support from additional sources. Furthermore, additional research is needed to determine whether or not the sexes differ in the absolute amount and types of social support provided before additional recommendations can be made with confidence. In terms of sources of motivation, it appears that there are some reliable differences that can be addressed when working with females. For example, as opposed to focusing on competition and perceptions of others, it appears that girls and women may benefit more from a focus on health and wellness outcomes. All in all, with these relationships in mind and more attention paid to how men and women may respond to and engage in physical activity in different

ways along psychosocial parameters, it is hopeful that future interventions can be better tailored and more successful at increasing activity and exercise and reducing the health risks in females of all ages.

Author Contributions

Conceived original concept for the paper: ESE. Conducted reviews of literate: ESE and SCS. Contributed to the writing of the manuscript: ESE and SCS. Jointly developed the structure and arguments for the paper: ESE and SCS. Made critical revisions and approved the final version: ESE and SCS. All the authors reviewed and approved the final manuscript.

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