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Review Article

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Male and Female Differences in Health Benefits Derived from Physical Activity: Implications for Exercise Prescription

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Abstract

Males are consistently reported as more physically active than females regardless of age or measure. Often, this difference results in females identified as under active and at risk of long-term poor health outcomes. In this paper a different perspective drawing on evidence from many sources is offered. Males and females gain different health benefits according to the level, mode and intensity of the physical activity. Some potential ramifications of these gender differences in health benefits are evident in the prevalence of hypokinetic diseases across the life span and the interpretation of measured physical activity levels and intensities. By focusing on these differences, this papers highlights the need to take a more divergent view of what exercise really means, and how it provides health needs differently for males and females. We identified important implications for public policy and physical activity guidelines.

Keywords

Gender difference; Sex difference; Exercise; Health; Physical activity guidelines

Introduction

The positive physical, social and emotional health benefits conferred by physical activity are clearly established and underpin the public health rationale for advocating sufficient daily levels of physical activity [1]. To date, recommended levels of physical activity in many countries are the same for male and female children and adults. For example, Australian recommendations are 60 minutes of moderate to vigorous physical activity/day for children and 30 minutes/day for adults, but there is no further refinement related to gender. Furthermore, health professionals continue to overlook the possibility that females' requirements for exercise might well differ to that of males [2]. When the level of physical activity has been measured females are consistently identified as 6-10% less physically active than males, regardless of measurement instrument, protocol or definition [3-6]. Several questions arise. To what extent do females' lower levels of physical activity compared to males impact upon their health? Further, is the premise that the "one size fits all" approach the most appropriate method of engaging men and women, boys and girls in meaningful and beneficial physical activity? These questions become even more pertinent when considering that overall, most men have lower health status than women in spite of their overall higher level of physical activity [7]. For example, males are at a greater risk of cardiovascular disease and hypertension than premenopausal women [8]. In 2007, the male age-adjusted death rates for CVD, was almost 75% higher than females, and was the highest contributor to potential years of life lost in males [9]. Therefore even though females are exercising less than their male counterparts, it does not automatically follow that they are less healthy.

In order to encourage everybody to be sufficiently and meaningfully physically active, it is important to consider the different needs and preferences according to gender, mode and context. It is apparent that differences between males and females exist across the lifespan. Males are more physically active in utero [10], infanthood [11-13], childhood [14], adolescence [6], adulthood [5] through to old age. Based on these differences females are often considered at risk of poor health outcomes and identified as a high priority group for physical activity interventions [15]. However, there is little evidence in the literature indicating that lower physical activity levels and intensities are a health concern for women. As a result, the purpose of this paper is to draw on a broad range of literature in order to challenge the current view that males and females need to exercise at the same level and intensity to derive the same health benefits.

Huxley argues that historically there has been a failure to acknowledge the physiological differences between male and female and how these might impact on sex specific pathophysiology and implementation of appropriate cardiovascular disease treatments [16]. She points out that many of the data on healthy humans came from Caucasian men, 18 to 20 years of age drawn from the military, athletic, or medical schools. One cannot generalize the exercise responses to females or indeed to males who do not fit this profile. Furthermore Wen et al. identified that life expectancy and hazard ratios for mortality risks differed for males and females in relation to volume of physical activity based on MET hours/week [17]. It is already well established that both males and females gain the largest health benefit when activity increases from sedentary to low level intensity [18-20]. However, differences between males and females emerge when physical activity increases beyond low intensity. Whereas males gain health benefits from vigorous physical activity (>6 METs) [19-21], evidence has emerged that important health benefits can be achieved by females from time spent in physical activity as low as 15 minutes per day and at low (<3 METS) to moderate (3-6 METs) intensities [22]. Many studies, particularly those involving post-menopausal women, have shown most women gain little from increasing physical activity to a vigorous intensity [23]. Overall, it appears that women gain more benefit than men in reduction of mortality, when increasing physical activity from low to moderate intensity [17-20]. Therefore, the current emphasis on the importance of moderate to vigorous intensities of physical activity for health in everyone may not be as applicable to females as it is to males.

Issues surrounding physical activity and health arise from the complex interaction of biological, environmental, and behavioral

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factors. Based on this understanding, the purposes of this paper were to 1) examine male and female differences in health benefits derived from exercise response at varying levels and intensities, 2) describe gender differences in terms of biological structure and function and psychosocial development, and 3) identify possible explanations for gender differences in physical activity levels. The final purpose of the paper was to discuss implications for both theory and practice. While sex is generally conceptualized as a biological construct and gender as a sociological construct, for the purpose of this paper we define gender in the very broad sense to encompass the interaction between biological and socio-environmental factors that influence health behavior [24].

Gender differences in health benefits derived from exercise

Gender differences exist in the benefits of different levels of physical activity specific to a range of poor health outcomes. For example, low to moderate intensity physical activity, including brisk walking, provides protection from cardiovascular disease [22,25-28] and diabetes to a greater extent among women [29] compared to men. In a recent meta-analysis of 33 studies, Sattelmair et al. showed that the relative risk for coronary heart disease reduced more rapidly with lower levels of physical activity for women than it did for men [22].

In some forms of cancer there is a relationship between level of physical activity and risk reduction in which gender may also play a role. For example Friedenreich et al. identified that in colon cancer, risk reduction was related to increased leisure time activity among females. However for males the risk reduction was associated with both leisure and occupational physical activity. With regards to lung cancer, they reported that physical activity does not seem to be related to risk reduction for non-smokers, whereas there is evidence that it confers some protection for smokers. Friedenreich et al. reported that this effect is more apparent in recreational activity for men than in women compared to work-related physical activity. In gender-related cancers there are also different responses to risk reduction with exercise. Breast and endometrial cancer risks are reduced by many types of activity including household and recreational activity, with endometrial cancer risk showing a reduction with light to moderate activity [30]. There is some evidence to support an association between reduced risk of prostate cancer and higher levels of physical activity, however it varies with the type of prostate cancer. The more aggressive forms are more likely to show reduced risk with physical activity. It appears that there is still a need to better understand the type of physical activity and the dose response to achieve significant reductions in many forms of cancers [30].

Gender effects are further complicated when one considers mental health benefits derived from physical activity. From a national survey of over 6000 24 to 65-year-old adults Asztalos et al. found that for men, participation in vigorous intensity physical activity lowered feelings of depression, anxiety and physical symptoms of such mental stress (somatisation) [31]. The fact that men are engaging in higher levels and greater intensity of physical activity could be less detrimental to their mental health. On the other hand, the authors found that for women, walking was positively related to emotional well-being and moderate intensity physical activity reduced symptoms of somatisation. They propose that walking, in particular, may enable opportunities for social interaction and bonding which is highly valued among women. They concluded that men gain more benefit from vigorous physical activity whereas women gain from lighter activity. Morimoto et al. [32] found differential effects of physical activity on health-related quality of life in both men and women, but women had more preferable effects than men. It appears that by participating in lower intensity physical activity, women are likely to be better off in terms of their mental health. For example, the physical activity requirements of a new mother are likely to be affected by biological, environmental and psychological influences which would differ from their male counterparts [33]. These are just a few examples showing different sex-related responses to varied levels of physical activity when mental health outcomes are considered. In summary, we argue that mental health related benefits can be achieved by women with moderate exercise, which seems to be their preferred level [31]. The differences in response to physical activity may be explained by biological differences between males and females.

Gender differences in biological structure and function

Although it is generally assumed that physical activity level is under voluntary control, there are a number of biologically driven influences. From the moment of conception, males and females differ anatomically and follow different patterns of development. Their brains differ in composition [34], overall size [35], regional proportions [36], connectivity [37] and maturation processes [38]. For example, female brains have more grey matter and male brains have more white matter and cerebrospinal fluid [34]. It may be that these neurological differences drive human development towards gender-aligned behaviours, including preferences for and attraction to physical activity. Although to date, no studies have directly linked these structural differences to physical activity levels, these are important links that need to be explored. It is possible many of the behavioural and cognitive differences observed between males and females, such as verbal and visuo-spatial tasks [34,39] could be partly explained by the information above.

Other early biological gender differences may also contribute to the differing physical activity levels. For example, males are longer and heavier at birth [40], have a greater vital capacity and proportionately larger heart and lungs than females [41]. With physical maturity, male muscles become stronger, larger cross-sectionally, and comprise larger muscle fibres than females [42], particularly in the upper body [43]. Such physical differences advantage the male in physical activity.

Combined with these physical differences, male cardiovascular physiology also means they are more biologically capable of vigorous physical activity than females. For example, males have lower heart rates when engaged in similar rates of exercise [16,44], higher VO_2 max levels relative to body mass [45,46], higher red blood cells per unit volume of plasma, wider airways and greater lung diffusion capacity [47]. When placed under cardiovascular stress, males respond by increasing vascular resistance, and consequently blood pressure, whereas women increase heart rate and are more at risk of fainting [16]. These performance differences are acknowledged by the gender-specific norms for exercise-related tests such as lung function values, VO_2 norms, blood pressure and prediction of maximum aerobic power [48].

There is also some evidence of gender differences in response to various training regimes. For example, Collier [49] found that resting diastolic blood pressure decreased in women whereas arterial stiffness increased in men after 4 weeks of resistance training. Even sources of metabolism differ between gender, for example, females oxidise more lipid and less carbohydrate and protein than males during endurance exercise at a low intensity [50]. Many of these observed differences in exercise response may be attributed to genetic differences, biological regulating factors, in particular the sex hormones, or a combination of both [51]. Emerging evidence from some animal studies show that estrogen, progesterone and testosterone differentially mediate exercise response and consequently physical activity in males and females [16,52,53].

Gender differences in psychosocial development

It has been argued that the observed difference in physical activity levels and exercise behavior between males and females may be a reflection of human evolution. For example, Darwin suggested that males need to be strong, fit and courageous to compete with other males to attract a suitable mating partner, so therefore, are biologically predisposed to be more active [54]. Societal expectations also play a powerful role in molding male and female behaviours. The relative contribution of nature versus nurture continues to be debated and is beyond the scope of this paper. Repeatedly it has been shown that males and females differ in their attitudes and motivations towards sport and exercise across the life span [55-58]. When compared to girls, Brustad identified that boys are more attracted by physical exertion which in turn influences their participation choices. For boys, the demonstration of physical prowess and social status is generally the more important goal. By contrast, girls tend to be more motivated by friendships, personal satisfaction, body image and self-expression [57,58].

Gender differences in motivation and attitudes, combined with varied parent expectations [59] manifest into a range of play and activity patterns among children [60,61]. Boys' games are generally more boisterous and involve speed, strength, endurance, and aggression [62]. On the other hand, girls play less vigorously and are more likely to compete relationally, engage in play parenting [63], focus on turn-taking, orderly sequences, partial involvement or solitary activities [64]. When at school, girls spend more time in smaller same-sex groups and engage in verbal games, conversation and socializing, whereas boys play in larger groups, which lend themselves to more physically active team games, such as football [65]. Such differences become more pronounced with age and are socially reinforced by parents and others to become embedded with sex role stereotypes.

Should we be concerned for women?

Considering the importance of physical activity for health and the prevention of disease [1], one consequence of females' lower physical activity level is that they are assumed to be at greater risk in terms of their health status. Consequently, researchers, practitioners and policy makers frequently recommend strategies are needed that encourage females to increase their level of physical activity to meet recommended standards. To date however, there is no clear evidence, that these lower measured physical activity levels and intensities are a health concern for women. When the prevalence of males and females for health outcomes and diseases associated with insufficient physical activity are compared, females are generally not more heavily represented, although they may show a different profile compared to males. . In explaining a range of these differences including heart disease, cancer, and obesity, Newman and Brach [66] proposed that gender difference in longevity, health status and disability is based upon the "complex interaction of environmental, behavioral, and biological factors", many of which are outlined above.

Summary

Evidence that health benefits derived from physical activity differ for males and females according to level, mode and intensity was presented in this paper. In addition, it was shown that they also engage in, and respond to, physical activity opportunities in varying ways. There was little convincing evidence that vigorous activity provides more health benefits across the lifespan than moderate physical activity, particularly for females. The evidence presented in this paper raises a number of implications for both theory and practice and should trigger a robust discussion.

There are clear limitations to a "one size fits all" approach for recommending doses of exercise or physical activity to achieve health benefits at the population level. When it is so often stated that females are insufficiently active in comparison to males, it is probably because their different responses to exercise have not been taken into account. The current emphasis on engaging in moderate to vigorous physical activity may not be appropriate for everyone. Therefore, the current generic physical activity recommendations need to be reviewed. As gender-specific physical activity guidelines are not presented, it is inappropriate to make judgements as to whether females are sufficiently active.

We recommend the use of gender-disaggregated statistics proactively in planning to gauge the extent to which women and men benefit from or are affected by policy. In general, it is argued that public policy should be monitored for gender impact and refined as appropriate to take gender differences into account and promote gender equity.

Further, the needs of both males and females are likely to change differentially over the lifespan. For example, the value of some exercises, such as walking, which might be considered low physical activity, may be most effective at improving some aspects of health for women.

Finally, we need to acknowledge the extensive published, peer reviewed research that males and females are different and respond differently to physical activity. In future research there is a need to consider gender differences when interpreting measures of physical activity. Implications may be flawed if there is a failure to acknowledge the fundamental differences highlighted above. Further it is not possible to fully understand these differences without addressing the current limitations in the valid and accurate measurement of physical activity. At present, physical activity in both children and adults is measured using a wide range of both objective and subjective tools, therefore comparisons between studies are difficult. Furthermore, it is important to ensure that the measurement protocol does not advantage one gender over the other.

Conclusion

Increasing physical activity levels in child and adult populations is a health-related priority. However, the differential influences of sex-related biological and genetic factors in response to environmental and cultural factors are largely ignored. When interpreting physical activity related information, for example in the formation of guidelines, there needs to be consideration of different needs across the lifespan, as gender differences fluctuate with age. To conclude, males and females are predisposed to engage in different levels of intensity and type of physical activity. We need to reconsider how these differences are reported and responded to in both policy and practice. Future research and debate is recommended to examine the complex interactions between environmental, behavioural and biological factors with gender and physical activity.

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