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Review

Women and exercise in aging

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Abstract

Aging is associated with physiological declines, notably a decrease in bone mineral density (BMD) and lean body mass, with a concurrent increase in body fat and central adiposity. Interest in women and aging is of particular interest partly as a result of gender specific responses to aging, particularly as a result of menopause. It is possible that the onset of menopause may augment the physiological decline associated with aging and inactivity. More so, a higher incidence of metabolic syndrome (an accumulation of cardiovascular disease risk factors including obesity, low-density lipoprotein cholesterol, high blood pressure, and high fasting glucose) has been shown in middle-aged women during the postmenopausal period. This is due in part to the drastic changes in body composition, as previously discussed, but also a change in physical activity (PA) levels. Sarcopenia is an age related decrease in the cross-sectional area of skeletal muscle fibers that consequently leads to a decline in physical function, gait speed, balance, coordination, decreased BMD, and quality of life. PA plays an essential role in combating physiological decline associated with aging. Maintenance of adequate levels of PA can result in increased longevity and a reduced risk for metabolic disease along with other chronic diseases. The aim of this paper is to review relevant literature, examine current PA guidelines, and provide recommendations specific to women based on current research.

Keywords: Aerobic; Exercise prescription; Flexibility; Older adults; Strength training

1. Introduction

It is anticipated that there will be almost 89 million people 65 years old or above by the year 2050.[1] As the number of elderly people worldwide increases,[2] interest in health related outcomes of aging has concurrently increased. It has been suggested that an age-associated decline in physical function, cardiorespiratory fitness, and muscle mass may accelerate the physiological decline in later decades of life[3] and lead to an increase in morbidity and mortality rates.[2,4]

Women are of particular interest due to some gender differences accompanying aging, particularly as a result of menopause. Physiological decline, particularly a reduction in bone mineral density (BMD) can be attributed to estrogen deficiency as a result of menopause.[5] Reductions in BMD put older women at risk for osteoporosis which can lead to balance and gait issues, a higher risk of injury, subsequent financial costs,[6] and even a higher risk of mortality.[2] More so, a decrease in muscle strength in combination with reduced BMD can further impair balance and mobility, leading to a decline in functional capacity.[7] Thus, it becomes apparent of the need for resistance training to attenuate the decline in lean mass, muscle mass, and BMD that accompany aging and inactivity. Other physiological changes that occur with aging are alterations to the cardiovascular (CV) system, which can further impair functional capacity. Remarkably, by the age of 75 years, more than half of the functional capacity of the CV system has been lost,[8] leading to VO_{2max} values lower than that which is required for many common activities of daily

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living.[9] More than just leading to decreases in quality of life, low cardiorespiratory fitness has been associated with CV disease and all-cause mortality.[10−12] The CV system remains adaptable at any age,[13,14] with relative increases in VO_{2max} in older populations equivalent to those seen in younger individuals.

Physical activity (PA) has long been associated with the attenuation of physical decline associated with aging.[15] The purpose of this article is to:

1. Examine the decline in physiological variables associated with aging and a sedentary lifestyle.
2. Review recent research investigating exercise interventions on health related components in women.
3. Provide recommendations for PA that build on prior research and guidelines to improve physiological functioning in aging women.

2. Physiological decline with aging and inactivity

Aging is associated with physiological declines, notably a decrease in BMD and lean body mass (LBM), with a concurrent increase in body fat and central adiposity.[16,17] It is possible that the onset of menopause may augment the decline in physiological decline associated with aging and inactivity.[5] Wang and colleagues[18] compared almost 400 early postmenopausal women and found higher levels of total body fat, as well as abdominal and android fat in postmenopausal women. Consequently, the authors could not conclude that the changes in body fat were related to menopause or merely a result of aging alone. The authors did note, however, that changes in fat-free mass (FFM), including bone mass, may be attributed to menopause-related mechanisms, including deficiencies in growth hormones and estrogen. Douchi et al.[5] had similar findings when comparing body composition variables between pre- and postmenopausal women. The authors demonstrated an increase in percentage of body fat (30.8% ± 7.1% *vs*. 34.4% ± 7.0%), trunk fat mass (6.6 ± 3.9 kg *vs*. 8.5 ± 3.4 kg), and trunk−leg fat ratio (0.9 ± 0.4 *vs*. 1.3 ± 0.5) with aging. Concurrently, they found that lean mass (right arm, trunk, bilateral legs, and total body (34.5 ± 4.3 kg *vs*. 32.5 ± 4.0 kg)) also declined with age. Baker and colleagues[19] found that females had a greater decline in BMD with age compared to males. More so, a higher incidence of metabolic syndrome (an accumulation of cardiovascular disease risk factors including obesity, low-density lipoprotein cholesterol (LDL-C), high blood pressure, and high fasting glucose) has been shown in middle-aged women during the postmenopausal period. This is due in part to the drastic changes in body composition, as previously discussed, but also a change in PA levels. In a longitudinal study of over 77,000 (34−59 years) women spanning 24 years, van Dam et al.[20] found high body mass index (BMI, 25+) and lower levels of PA (<30 min/day of moderate to vigorous intensity activity) to be attributed with a higher risk of CV disease, cancer, and all-cause mortality. Furthermore, Sisson et al.[21] found higher levels of sedentary behavior (<4 h/day) associated with a 54% increase in risk for metabolic syndrome only in those women not meeting national guidelines.

Sarcopenia is an age related decrease in the cross-sectional area of skeletal muscle fibers that consequently leads to a decline in physical function, gait speed, balance, coordination, decreased bone density, and quality of life.[22] Additionally, due to lower levels of vigorous activity, aging populations experience notably higher losses in type II fibers than type I fibers,[23] which can reduce strength, speed, power, and overall PA. Subsequently, maintenance of muscle mass and strength is imperative to maintain a high quality level of physical functioning, and attenuate measures of frailty. Muscular adaptations to exercise (increase in muscle size, cross-sectional area, and consequent strength) may counteract muscle loss and physical decline associated with sarcopenia.

Thus it appears that PA plays a pivotal role in the attenuation of physical decline and can potentially improve physical functioning and quality of life with age.[24,25] Furthermore, maintenance of adequate levels of PA can result in increased longevity, and a reduced risk for metabolic disease along with other chronic diseases. A list of physiological changes associate with different modes of activity and their potential health outcome are listed in Table 1.[26−28]

3. CV exercise

CV disease is the major cause of death in older women.[29−31] It therefore becomes of utmost importance to decrease the risk for CV disease. Cross-sectional and intervention studies have repeatedly shown that endurance training can improve insulin sensitivity,[32,33] lower blood pressure,[34] improve lipid profiles,[35−37] and decrease body fat,[36−38] all factors related to CV disease. Furthermore, aerobic exercise has been shown to increase VO_{2max}, an index of cardiorespiratory fitness that on average decreases 5%−15% per decade after the age of 25.[39] These physiological responses to aerobic exercise results in an increased efficiency of the system during exercise (increased stroke volume, capillary, and mitochondrial density; lower heart rate and blood pressure) and ability to better deliver oxygen and glucose to working muscles.[40]

In an investigation into the level of activity that may protect against CV disease mortality, Hamer and Stamatakis[41] recruited 23,747 men and women without a known history of CV disease at baseline. The researchers tracked PA levels and causes of death over a period of 7.0 ± 3.0 years. By calculating a hazard ratio (HR), the authors found that a minimum of two sessions of moderate to vigorous PA per week was associated with a reduced risk of CV disease and all-cause mortality. Compared to active adults, those individuals who were inactive were at elevated risk of CV disease (HR of 1.41 *vs*. active: HR of 0.82) and all-cause mortality (HR of 1.50 *vs*. active: HR of 1.11). Supporting these findings, several studies have demonstrated walking, or walk−jogging, for 30−60 min, 2−5 days per week can significantly decrease body weight, increase BMD and VO_{2max}, and improve glucose levels in older women.[42−45]