Effects of Exercise on Menopausal Prevalent Conditions

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30.1 Introduction

Physical activity is the antidote to sedentary lifestyle and its consequences, and includes all forms of muscle movement. Physical activity may range from ordinary activities such as walking or household tasks up to other hard tasks, such as sports or several active leisure pursuits. Exercise refers to physical activity specifically intended to improve health and/or fitness. There are three main types of exercise: stretch, strength, and aerobic exercises. Stretch exercising allows avoiding injury and ameliorates performance; strength exercise helps control weight and also avoid injury while stimulating bone formation; and aerobic exercise protects cardiovascular health, that consumes fat mass and contributes at maintaining a healthy weight and fitness.

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Physical activity induces cardiocirculatory, endocrine, and metabolic benefits. Scientific research during the last three decades has demonstrated that exercise is a countermeasure against obesity, cancer, cardiovascular disease, and even mortality. It seems that exercise stimulates the immune system [1], mobilizes and delivers oxygen and substrate to maintain energy turnover [2] and modifies genetic susceptibility to obesity [3]. In addition, myokine and myometabolites may interfere against degenerative diseases and the ageing of systems [4]. The term exercise corresponds to physical activity aimed at improving health and fitness. Programmed exercise has been used to study different health outcomes. Programmed exercise is frequently recommended for peri-, postmenopausal and older women. Although programmed exercise may have benefits, some recommendations have been based on the results from observational studies, and thus clinical effects are less than expected.

The menopausal transition is associated with endocrine adjustments and changes in social environment. During this stage, several symptoms and co-morbid complications are frequent and may vary in intensity and duration. Although vasomotor symptoms are perhaps the most frequent during those years, others may prevail for longer periods and can be more prevalent than vasomotor symptoms, such as changes in body composition and metabolic outcomes, depressive symptoms, musculoskeletal pain, insomnia or sleep disturbances, and both muscle mass and performance [5–10]. Despite several studies, it has been difficult to establish the true relationship between the benefits of exercise on these symptoms or conditions during the second half of female life. The purpose of this chapter is to review current data from selected observational studies, randomized controlled trials (RCTs), and meta-analyses regarding the effects of programmed exercise on body composition, insulin sensitivity and metabolic endpoints, vasomotor symptoms, sleep quality, and emotional prevalent conditions (depressive symptoms, anxiety, and perceived stress) in women during the second half of life.

30.2 Changes in Body Composition and Physical Activity in Mid-Aged and Older Women

Ageing and menopause have impact on body composition, physical fitness, and exercise. Changes in body composition is also a marker of the risk of chronic diseases. Around the menopause, there are changes in body composition, although weight may stay stable. Total fat mass progressively increases, with a selective accumulation in the intra-abdominal compartment, whereas subcutaneous fat may stay stable [11]. During early postmenopausal years, the level of physical activity is responsible for the variations of fat distribution that occured during the menopausal transition, while the menopause onset, *per se*, has a secondary role [12].

Longitudinal studies in perimenopausal women have shown that there is some reduction in energy balance which contributes to total and abdominal fat accumulation. In general, body fat and weight increased significantly over time only in those women who became postmenopausal. Using dual-energy X-ray absorptiometry

(DEXA) one study reported [13] that 2 years before the onset of the menopause, physical activity decreased and remained low. Follow-up studies using magnetic resonance imaging (MRI) indicate that during the menopausal transition, total abdominal fat increases despite no changes in body weight, waist circumference, and physical activity, and this evolution was not related to the menopause [14]. In non-obese premenopausal women (mean age 49 years at baseline), a longitudinal study showed that there is an increase in fat mass, fat mass percentage, trunk fat mass, visceral fat, plasma glucose, and high-density lipoprotein cholesterol (HDL-C). However, women did not have metabolic deterioration during the 5-year follow-up [15].

Using MRI, Withaker et al. [16] reported that body mass index (BMI), visceral adipose tissue (VAT), and subcutaneous adipose tissue (SAT) accrual in adult men and women increased over a 7-year period. Changes in BMI were smaller than those observed for VAT, SAT, and VAT/SAT ratio. In addition, VAT, SAT, and VAT/SAT gain decreased linearly, and this deceleration was greater in men than in women.

The main objective of physical activity and programmed exercise is to maintain a healthy body composition and functional/physical independence. Physical activity can improve body composition, although it can be masked if only body weight or BMI is measured, and the benefits of exercise are more pronounced in postmenopausal women than in premenopausal ones. In addition, estrogen hormone therapy can also provide benefits to body composition [17]. Walking interventions produce beneficial changes in body composition in peri- and postmenopausal women. A meta-analysis of RCTs reported that walking for at least 4 weeks produced a significant reduction in BMI, body weight, and body fat percentage [18].

In young people, strength training improves body composition. In middle-aged women, body fat is reduced 1.3% and fat-free mass increased 656 g for each day per week of training. Therefore, this type of exercise has a better impact on body composition while age, energy, and protein consumption have small effects. Despite this, when results are adjusted for differences in physical activity and menopausal status the correlations weakened significantly [19].

A RCT regarding a 12-month exercise program, including aerobic and muscle strength training in sedentary postmenopausal women (50–69 years), was not associated to changes in weight, BMI, and hip circumference although total body fat and percentage of body fat were reduced when compared to the control group [20]. Therefore, exercise induced changes in body composition and had a positive effect on fat distribution. A meta-analysis of RCTs of menopausal women reported a moderate effect of short-term exercise on body fat mass, waist circumference, triglyceride levels, and bone mineral density as compared to women who did not perform exercise [21].

A high adherence to a healthy dietary pattern (Mediterranean diet) is inversely associated with overweight/obesity in peri- and postmenopausal women. The occurrence of low to severe problems during female midlife is positively associated with overweight/obesity. It seems that a high adherence to the Mediterranean diet pattern and a body mass index of 25 kg/m^2 or lower may improve quality of life in peri- and postmenopausal women [22]. Dietary and exercise intervention may reduce body weight and improve body composition in obese peri- and postmenopausal women.

A meta-analysis of RCTs showed that a combination of diet and exercise was associated with greater weight loss than dietary intervention alone. In addition, diet combined with exercise produced greater fat and lean mass loss than diet alone. It seems that exercise may enhance the changes produced by diet over body weight and composition [23].

In healthy older women (aged 61–81), combined aerobic and low- to moderate-intensity exercise for 10 weeks increased muscle strength and gait speed, independent of the order of the exercise combination. In addition, there was improvement in dynamic balance with moderate-intensity combined training [24].

There is a great discussion regarding the importance of lifestyle and exercise in older subjects with sarcopenic obesity in terms of improving muscle mass and performance, and therefore indirectly preventing falls (and thus fractures). A recent meta-analysis of RCTs reported that exercise alone or combined with dietary supplementation for at least 6 weeks in elder individuals increased grip strength (upper extremity performance), gait speed (lower extremity performance), and appendicular skeletal muscle mass. In addition, both interventions were associated with a reduction of waist circumference, total and trunk fat mass. Therefore, exercise may improve both body composition and muscle performance even in that particular population [10].

30.3 Effect of Exercise on Insulin Sensitivity, Anthropometry, and Metabolic Outcomes in Postmenopausal Women

Physical activity and regular exercise may improve different endocrine endpoints, including insulin sensitivity, glucose homeostasis, and lipid metabolism. Physical activity and exercise (all types of muscular activity) are key factors at maintaining glycemic control and insulin sensitivity. Physical activity may also contribute at avoiding excessive body weight and co-morbidities such as hypertension, dyslipidemia, the metabolic syndrome, and some cancers related to insulin resistance.

Data regarding the effects of exercise on insulin sensitivity in postmenopausal women is controversial. We recently performed a systematic review and meta-analysis of seven RCTs regarding the effects of programmed exercise for at least 12 weeks of duration on insulin and related outcomes, anthropometric endpoints, and metabolic blood variables [25]. Displayed in Table 30.1 are the effects of programmed exercise on circulating levels of insulin, insulin growth factor 1 (IGF-1), IGF-binding protein 3 (IGFBP-3), and values of the homeostatic model assessment-insulin resistance (HOMA-IR). The duration of programmed exercise was classified as “mid-term exercise intervention” (MTEI) for 3–4 months; and “long-term exercise intervention” (LTEI), corresponding to 6 to 12 months of duration. Among the most important findings were that exercise for 3–4 months was associated with significant lower circulating insulin levels and a reduction of the HOMA-IR values when compared to controls; while there were no significant effects of exercise intervention of 6–12 months in comparison to controls. In addition, there were no significant differences for circulating levels of IGF-1, glucose, and triglycerides with

Table 30.1 Meta-analysis of randomized controlled trials: mean differences (and 95% confidence intervals) between baseline and post-intervention regarding primary and secondary hormone and metabolic outcomes

Outcome	Exercise interventions (*n*)	Exercise (*n* = women)	Control (*n* = women)	Mean difference (95% CI)	I^2 (%)	*P*
Insulin (pmol/L)						
– Mid-term EXE intervention	3	110	109	−6.50 (−11.19; −1.82)	0	0.006
– Long-term EXE intervention	4	269	222	−6.73 (−16.91; 3.44)	0	0.19
HOMA-IR						
– Mid-term EXE intervention	3	110	109	−0.18 (−0.34; −0.03)	0	0.02
– Long-term EXE intervention	3	229	199	−0.13 (−0.76; 0.50)	39	0.68
IGF-1 (ng/mL)						
– Mid-term EXE intervention	2	109	107	30.98 (−41.68; 103.64)	87	0.40
– Long-term EXE intervention	2	204	173	0.66 (−12.09; 13.41)	0	0.92
IGFBP-3 (ng/mL)						
– Long-term EXE intervention	2	204	173	−307.15 (−848.62; 234.33)	64	0.27
BMI (kg/m^2)						
– Mid-term EXE intervention	3	45	44	−1.48 (−2.48; −0.48)	0	0.004
– Long-term EXE intervention	3	182	136	−0.72 (−1.92; 0.48)	0	0.24
Waist circumference (cm)						
– Mid-term EXE intervention	3	45	44	−1.87 (−3.02; −0.72)	0	0.001
– Long-term EXE intervention	3	182	136	−3.74 (−6.68; −0.79)	0	0.01
Weight (kg)						
– Long-term EXE intervention	3	182	136	−1.67 (−5.40; 2.06)	0	0.38

(continued)

Table 30.1 (continued)

Outcome	Exercise interventions (*n*)	Exercise (*n* = women)	Control (*n* = women)	Mean difference (95% CI)	I^2 (%)	*P*
Body fat (%)						
– Mid-term EXE intervention	3	45	44	−2.99 (−4.85; −1.14)	0	0.002
Glucose (mmol/L)						
– Mid-term EXE intervention	3	110	109	−0.38 (−0.88; 0.11)	66	0.13
Long-term EXE intervention	4	269	222	0.00 (−0.13; 0.14)	12	0.97
Triglycerides (mmol/L)						
– Mid-term EXE intervention	3	110	109	−0.13 (−0.30; 0.03)	0	0.12
– Long-term EXE intervention	3	152	135	−0.07 (−0.26, 0.12)	0	0.47

Heterogeneity of studies as measured by I^2. Data from Bueno-Notivol et al. [25]
BMI body mass index, *CI* confidence interval, *EXE* exercise, *HOMA-IR* homeostasis model assessment of insulin resistance, *IGF-1* insulin growth factor 1, *IGFBP-3* insulin growth factor binding protein

both MTEI and LTEI. On the other hand, there was a significant reduction in BMI and body fat percentage after MTEI, and in waist circumference after both MTEI and LTEI [25].

Postmenopausal women have lower body fat oxidation and lower energy expenditure during exercise, and some four kg less of lean body mass (LBM) than premenopausal women [26]. In non-obese late premenopausal and early postmenopausal women, performing high-intensity aerobic exercise for 3 months reduced body weight, waist circumference, and fat mass while increasing lean body mass. This programmed exercise reduced diastolic blood pressure, total cholesterol, low-density lipoprotein-cholesterol (LDL-C), and improved insulin response during the oral glucose tolerance test [27]. Training increased insulin sensitivity by several mechanisms, including augmented expression of hexokinase and glycogen synthase, and the dephosphorylation of glycogen synthase [28].

Metabolic and endocrine effects may vary depending on the type of exercise. For instance, a 60 min session of Nordic walking intervention, three times/week, for 12 weeks produced beneficial changes on BMI, fat mass, insulin levels, blood pressure, and probably on endothelial function in healthy postmenopausal women [29].

Di Blasio et al. [30] reported that supervised walking training for 13 weeks in postmenopausal women produced a significant reduction of the plasmatic ratio of cortisol/dehydroepiandrosterone-sulfate (DHEA-S), which is related to the volume of exercise. A minimum training is needed to obtain the significant endocrine benefit. This kind of programmed exercise also influenced inflammatory markers [31].

30.4 Vasomotor Symptoms

Vasomotor symptoms, especially hot flashes and night sweats, sometimes associated with difficulty or disrupted sleep and depressive symptoms, are very common in peri- and postmenopausal women [32]. Duration and severity of hot flashes and night sweats are quite variable and more intense in obese women [33]. In general, these symptoms are related to estrogen changes and respond to hormone therapy. As adiposity increases during the menopause transition so do hot flashes, night sweats, and sleep disturbances. While adiposity increases insulin resistance, weight gain after menopause increases the prevalence of sleep apnea that may contribute to poorer sleep and a higher perception of nocturnal hot flashes and sweats [34].

In African American and Latin American women, vasomotor symptoms may persist for a median of 7 years during the menopausal transition, and may last for a longer time if there are negative affective factors, perceived stress, and a history of psychiatric consultation [35, 36]. Some women may complain of vasomotor symptoms even after their sixties. In Australian community-dwelling older women, vasomotor symptoms were associated with depressive symptoms [32].

The effect of physical activity and exercise over vasomotor symptoms is erratic or nil. Luotto et al. [37] reported that aerobic training may reduce hot flushes. The meta-analysis of the few available RCTs suggests that exercise versus no physical activity may have not benefit over the frequency or intensity of vasomotor symptoms. In addition, there were no differences between groups regarding the frequency or intensity of vasomotor symptoms when exercise was compared with yoga [38]. The Active Women Trial reported that a 6-month exercise intervention, with a further 6-month follow-up, reduced the weekly frequency of vasomotor symptoms; although the reduction was not statistically significant [39]. However, there were improvements in secondary outcomes such as depressive symptoms and anxiety, sleep quality, and sexual behavior, despite the fact that these improvements were not significantly different as compared to the control group. Therefore, the evidence suggests that exercise may have no benefits and thus no increase of physical activity should be advised [38, 39].

Yoga has been recommended for the management of vasomotor symptoms. Despite this, a RCT reported that Yoga among healthy women for a 12-week period did not improve vasomotor symptoms as compared to usual activity; although it may reduce insomnia as measured by the Insomnia Severity Index (ISI) [40]. Therefore, exercise, yoga, and other relaxation techniques are not recommended for the management of vasomotor symptoms [41]. In women with excessive body weight, exercise may initiate hot flashes in order to compensate the increase of body temperature. The final consequence is that exercise may be disappointing, and full belly breath and hydration are recommended to reduce exercise heat-induced hot flashes.

30.5 Sleep Quality and Insomnia

Insomnia and sleep disorders are very common in peri- and postmenopausal women, reaching in some populations up to 30–40% [5–7, 9]. Sleep disturbances may affect 45% of women aged more than 65 years, being associated with higher BMI and waist circumference. The presence of insomnia was inversely associated with physical fitness, and women without sleep disturbances showed better quality of life [42].

Insomnia is associated with sleepiness, fatigue, inability to concentrate in daily tasks, higher chances of accidents, tendency to gain weight, damage of personal or professional relationships, irritability and anxiety during the daytime [6]. Some sleep alterations may be related to hormone imbalances and menopause-related symptoms (mostly vasomotor symptoms and nocturia). However, women with mood disorders, particularly those with depressive symptoms and anxiety may have difficulty to fall asleep and/or early awakenings. In addition, chronic insomnia in mid-aged women may also be associated to different co-morbid conditions, including obstructive sleep apnea and the restless legs syndrome which require an appropriate assessment and treatment [43]. The consequences of poor nocturnal sleep are fatigue, sleepiness, irritability, and poor work efficacy. In postmenopausal women, the long-term consequences of poor quality of sleep and insomnia include increased morbidity and mortality [44, 45].

Menopause hormone therapy may improve both vasomotor symptoms and sleep disorders. However, the current use of hormones has decreased during the last decade or so. Hence, currently, the management of sleep disorders and insomnia can be approached by changes in lifestyle, specific pharmacologic medications, and alternative therapies [46].

There is a correlation between regular exercise and the reduction of insomnia mediated by a decrease of tension and body temperature, hence contributing to sleep and staying asleep. This is a reasonable alternative to the use of pharmacologic drugs. Full benefits may be obtained for instance by jogging up to five miles/week or by spending some time in the gym, and sometimes the best time for exercise is not later in the day. However, exercise in the evening may be associated with the benefits related to dietary habit modification [47].

Rubio-Arias et al. [48] reported a meta-analysis of RCTs assessing the effect in mid-aged women of programmed exercise for at least 8 weeks on sleep quality, sleep disturbance, and/or insomnia, using respectively the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI) (Table 30.2). Low-moderate levels of programmed exercise decreased the PSQI score as compared with controls. In a subgroup analysis, moderate aerobic exercise had a positive effect on sleep quality while programmed yoga did not have a significant effect on sleep quality. In three studies (two studies of yoga and one of aerobic exercise), there was a non-significant reduction in the severity of insomnia when compared to controls as measured with the total ISI score (Table 30.2).

A RCT reported that yoga and aerobic exercise interventions had no significant effects on sleep actigraphic sleep parameters in menopausal women with hot flashes and poor self-reported sleep quality [49]. Another RCT reported that progressive

Table 30.2 Meta-analysis of randomized controlled trials: mean differences (and 95% confidence intervals]) in sleep quality as assessed with the Pittsburgh Sleep Quality Index (overall effect and subgroup by type of physical activity), and insomnia with the Insomnia Severity Index

Outcome	Exercise interventions (*n*)	Exercise (*n* = women)	Control (*n* = women)	Mean difference (95% CI)	I^2 (%)	*P*
Pittsburgh Sleep Quality Index						
– Overall effect	5	354	396	−1.34 (−2.67; 0.00)	68	0.05
– Aerobic activity	3	198	226	−1.85 (−3.62; −0.07)	73	0.04
– Yoga	2	156	170	−0.46 (−1.79; 0.88)	0	0.50
Insomnia Severity Index	3	194	275	−1.44 (−3.28; 0.40)	0	0.13

Heterogeneity of studies as measured by I^2. Data from Rubio-Arias et al. [48]
CI confidence interval

relaxation exercises (once a week, for 8 weeks) and sleep hygiene training may improve insomnia in postmenopausal women as measured with the Women's Health Initiative Insomnia Rating Scale [50].

30.6 Effect of Exercise on Depressive Symptoms, Anxiety, and Perceived Stress

Reports indicate that exercise has benefits on the mental health, by creating a subjective sensation of well-being, but also through brain mechanisms improving the production of some neurotransmitters and neurotrophic factors that favor neuronal function and their connections. In addition, exercise may also contribute by regulating emotions and the respiratory function which may be positive for the anxious status [50]. However, clinical results cannot be generalized to different ages or conditions. We reviewed the most recent evidence from RCTs and meta-analyses related to women during their second half of life (Table 30.3).

30.6.1 Depressive Symptoms and Exercise

Depending on the diagnostic procedure, the prevalence of depressive symptoms may increase two-fold in women during their second half of life as compared to men [8, 53, 54]. It is important to consider that a large proportion of women with depressive disorders may have autoimmune thyroiditis [55]. In addition, depressive symptoms are more common among women who take antidepressants, are obese or tobacco consumers, live in insecure economic situations, have lower educational or economical level, have menopause-related symptoms (vaginal atrophy or vasomotor symptoms) or pelvic floor symptoms, and lack regular physical exercising. Contrary to this, having a partner and a paid job exerted a protective role [8, 32, 56].

Table 30.3 Meta-analysis of randomized controlled trials: standardized mean differences (and 95% confidence intervals) between baseline and post-intervention regarding depressive and anxiety symptoms

Outcome	Exercise interventions (*n*)	Exercise (*n* = women)	Control (*n* = women)	Mean difference (95% CI)	I^2 (%)	*P*
Depressive symptoms						
– Mid-term EXE intervention	7	368	441	−0.44 (−0.69; −0.18)	64	0.0008
– Long-term EXE intervention	6	602	573	−0.29 (−0.49; −0.09)	57	0.005
Anxiety symptoms						
– Mid-term EXE intervention	8	437	502	−0.42 (−0.81; −0.02)	87	0.04
– Long-term EXE intervention	7	536	477	−0.03 (−0.18; 0.13)	29	0.74

Heterogeneity of studies as measured by I^2. Data from Pérez-Lopez et al. [51] and Martínez-Domínguez et al. [52], respectively
CI confidence interval

Depressive mood affected 36% of mid-aged South American women (peri- and postmenopausal), with a higher rate observed among minorities (Afro-Colombian or Quechua women) due to ethnicity or other social discriminatory factors, hot flush severity, hormone therapy use, sedentary lifestyle, perceived unhealthy status, and lower educational level. Contrary to this, higher coital frequency and having a healthy partner without premature ejaculation were associated to less depressed mood [57].

The meta-analysis of few small RCTs reported that exercise may be mildly effective at reducing symptoms of depression, and compared to psychological or pharmacological treatments exercise seems to be less effective in adults aged 18 and over [58]. Exercise may be beneficial for people with mild and moderate depression and mood swings, if they are healthy enough to perform physical activity [59, 60]. A recent meta-analysis of RCTs suggests that exercise may be recommended in women during the second half of life with mild to moderate depressive symptoms, and the benefits may be obtained with exercise of low to moderate intensity (Table 30.3). The benefit of exercise was similar to physical activity of low and moderate intensity. Therefore, women with co-morbid conditions would benefit even with low-intensity physical activity [51].

It is likely that exercise be an opportunity for recreation and social meeting in women with depressive symptoms in their second half of life. In addition exercise improves motor and cognitive functions, and may be as effective as antidepressants [61]. Endorphins, cytokines, and other inflammatory markers have not been studied in peri- and postmenopausal women before, during, or after physical activity.

Exercise may also improve serotonin secretion since physical exercise modulates neurogenesis which is associated with mood improvement and changes in serotonin levels, tryptophan metabolism, and insulin sensitivity [25, 62, 63]. It is also possible that some muscle biochemical signals may improve central nervous system functions and reduce depressed mood [64].

30.6.2 Anxiety Symptoms and Exercise

Anxiety symptoms (ASs) are very prevalent among mid-aged and older women although there is no clear relationship with the menopausal transition. Available studies were characterized as having poor measurement of both menopausal status and anxiety symptoms; in addition, confounding factors such as severity of vasomotor symptoms or sleep disorders were not clearly assessed [65]. It has been postulated that the severity of the majority of menopausal symptoms, including anxiety symptoms, are related to the way recent life conditions and events are perceived during the midlife and later years [66]. It has been repeatedly reported that anxiety symptoms can be reduced by regular exercise, especially if having time to focus on breathing [67].

Several meta-analyses have studied the effect of exercise or physical activity on mild to moderate anxiety symptoms in the general population [68, 69]. However, a recent meta-analysis of RCTs including mid-aged and older women reported that mid-term (12 weeks to 4 months) programmed exercise of low to moderate intensity was associated with a mild and significant reduction of anxiety symptoms as compared to controls (Table 30.3). However, long-term exercise interventions for 6–14 months were not associated with a reduction of anxiety symptoms [52]. It seems that the benefits of exercise on anxiety symptoms are limited in time, becoming less effective over time. It remains to be demonstrated if more intense exercise can prolong or maintain the reduction of anxiety in long-term programmed exercise.

The aforementioned meta-analysis had some limitations, including the heterogeneity of analyzed RCTs, the use of small samples of subjects, limited information regarding secondary outcomes and confounding factors, and the lack of more objective endpoints including inflammatory markers.

30.6.3 Perceived Stress and Exercise

Perceived stress is a reaction to environmental conditions associated with the activation of the nervous system, negative sensations and, if sustained, with adverse health consequences. In addition, perceived stress is influenced by family and social factors, general health, smoking and other drug use, insomnia and anxiety, education, and financial difficulties. Different approaches have recommended including physical activity and exercise, psychological technique, relaxation, behavioral therapies, and programmed exercise.

Perceived stress is more prevalent in women than in men, with high rates among women during the second half of life [70]. Factors related with higher perceived stress include female age, lower education, lower psychological and urogenital quality of life, and financial difficulties [7]. Stress in premenopausal women is associated with a reduction in cognitive parameters such as attention, fluency, and language ability without affecting memory; while in postmenopausal women the majority of cognitive functions are reduced [71]. Longitudinal studies also showed that perceived stress is associated to increased C-reactive protein levels in women, but not in men [72].

According to observational studies, physical activity and exercise are recommended to reduce perceived stress [73, 74]; although there are controversial results in women during their second period of life (midlife and older women) [75–77]. We performed a meta-analysis of five RCTs regarding the effect of exercise on perceived stress, as measured with the Cohen Perceived Stress Scale, in middle-aged and older women [78]. Programmed exercise did not have any significant effect on measured perceived stress in mid-term and long-term interventions as compared to controls.

30.7 Effect of Exercise on Bone Mineral Density

There are several meta-analyses reporting the effect of exercise on bone mineral density (BMD) indicating a significant increase on femoral neck and lumbar spine BMD [79–81]. Contrary to this, another meta-analysis reported that in premenopausal women high-intensity progressive resistance training increased BMD at the lumbar spine but not at the femoral neck [82]. Future studies should provide better information on the effect of exercise at different ages and with different intensity and duration of physical activity.

30.8 Limitations of Current Evidence and Future Directions

The World Health Organization recommends that adults should engage in at least 150 min of moderate-intensity aerobic physical activity throughout the week or engage in at least 75 min of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity [83]. However, sedentary women can incorporate walking into their everyday life and progressively move to more intense exercise for major muscle groups. Daily activities, such as walking and climbing, have also shown health benefits and are consistent when people exercise over longer periods of time [84]. Despite this, there are also biased information from observational studies favoring exercise as the panacea for many aspects [85] which are not confirmed by RCTs.

The available evidence included a variety of types of exercise by intensity and frequency which are not comparable and do not allow a systematic assessment in order to define risks and benefits. The American College of Sport Medicine has Guidelines for Physical Activity in Adults with general recommendations for physical activity, aerobic activity, and strength activity [86]. Clinicians should counsel postmenopausal and older women on how much physical activity and programmed exercise is needed to maintain a healthy status, to promote weight loss and to maintain weight and obtain realistic expectations on the different outcomes reviewed in this manuscript.

Although the minimum recommended aerobic physical activity (150 min of moderate or 75 min of vigorous exercise per week) can improve cardiovascular health [87], the levels of programmed exercise should be tailored according to the outcomes to be corrected (insulin sensitivity, blood metabolic endpoints, emotional complaints), and according to the individual health status, age, and clinical goals. New alternatives to conventional programmed exercise, such as whole body electromyostimulation, or complements, such as adequate dietary supplementation, need to be assessed in postmenopausal women [10, 88].

Futures studies should incorporate more sophisticated and well-defined clinical and metabolic outcomes in order to improve the current limitations of available studies and define the effect of exercise on different prevalent conditions during the second half of life.

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