Physical Exercise and Cognition Among Women: Mobilization of Consolidatory Biomarkers

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Physical and neuropsychological health concerns, contrary to popular belief, are apparently not on the decrease, but rather, in more disadvantaged and even other global regions, are providing greater concern for poor health and prognosis [1-3] through lifestyle-induced disease states. In the context of physical exercise, gender studies exploring both differences and similarities in lifestyle-related mortality and morbidity imply a strong requirement for investigations pertaining to gender-specificity of health behaviour change process and factors influencing it. Observations linked to gender differences in health and lifestyle related mortality, morbidity and co-morbidity imply that the specificity of those factors affecting the ‘health-behavior-change process’ require closer examination in view of the dramatic health liability arising current levels of “gender-negligence” that constrain health investment. In a Finnish study of psychosocial parameters and exercise planning, no gender differences were found in self-efficacy and planning at baseline, although male participants reported receiving more social support than women. At 3-month testing, female participants reported the possession of a larger number of action plans for modulating their exercise routines than men. Among the latter participants, increments in self-efficacy and planning predicted increments in exercise. Among the former, changes in planning exerted a less significant role. The more salient the role of planning for women than for men, and the position that women receive less social support, may have reflected life circumstances allowing less spontaneous lifestyle decisions and a lower acceptance of lifestyle changes by their social environment [4]. Remarkably in certain global regions, 51 percent to 79 percent of adult populations worldwide appear to be inactive physically, i.e. failing to meet physical exercise level recommendations,
through their sedentary lifestyles accompanied by the rise in related morbidities/co-morbidities [5-7] and health hazards among the ageing [8]. These trends are related to observed epidemiological transitions, e.g. among Kenyans living Eldoret, a region otherwise famous for its internationally renowned athletes, and other sub-Saharan regions, wherein risk for cardiovascular disease is rising to such an extent as to attain uncontrollable levels [9-11]. In a sedentary Kenyan population of 50 or more years of age assigned to either short-duration (S), 5-10 min, or long-duration (L), 30-60min, exercise bouts (where at baseline obesity levels were: MaleS = 14.3%; MaleL = 38.5%; FemaleS = 92.3%; FemaleL = 69.2%), the 24-week exercise schedule culminated in reductions in obesity as follows: MaleS = 7.1%; MaleL = 15.4%; FemaleS = 61.5%; FemaleL = 30.8%, whereas the waist:height was reduced from MaleS = 64.3%; MaleL = 76.9%; FemaleS = 100%; FemaleL = 84.6% to MaleS = 42.9%; MaleL = 30.8%; FemaleS = 92.9%; FemaleL = 26.2% with similar reductions pertaining to waist:hip ratio and body composition relations for both genders [12].

For present purposes, the major ‘take-home’ message this Kenyan study pertains (i) to the excessive level of the female participants’ obesity levels and body composition, compared to the male participants, possibly of culture pressures (ii) the notable improvements induced by the exercise bouts over 24 weeks, and (iii) the advantage of long duration of moderate intensity exercise over short; similar improvements of cardio-metabolic profiles of 50 or more year-old adults was obtained, through comparisons of male and female participants with similar discrepancies of lipoproteins and glucose biomarkers [12]. In another Finnish study implementing the GOAL Lifestyle Implementation Trial data from 282 female participants, it was found that agency and the promotion of advances in self-efficacy both predicted independently waist circumference reduction during the 1-year follow-up whereby those individuals high in communion succeeded in waist-reduction progress, with cardiorespiratory, adiposity and heart rate variability associations [13], only if they received social support. Initial self-efficacy increase predicted 3-year waist-reduction progress. Gender-role orientation, together with social environment, influenced the ‘health-behavior-change process’ intervention outcomes [14]. Among both normal, healthy [15-17], those afflicted by poor health and others suffering clinical conditions, physical exercise generally affects health parameters in positive relations [18-20], and outcomes with negative effects due to over-exploitation, with problems arising mainly from sedentary lifestyles (Haapala et al., 2018) [21-24]. The purpose of the present account is to explore the presence/absence of eventual discrepancies in (i) male versus female propensities for exercise, whether under conditions of health or clinical disorder, and (ii) the efficacy of each gender in exploiting the manifold assets that may be obtained from pursuing the intervention.

Gender differences in both selective attention and memory performance have been reported [25-28], not least due to biological and physiological ongoing, functional determinants [29]; interestingly, with high levels of working memory performance among non-depressed pregnant women than among depressed pregnant women [30]. Physical exercise is associated with higher levels of a range of cognitive task performances among both younger and older participants, children, adolescents and young-older adults, whether male or female (e.g. [31-34]). Furthermore, acute/chronic, moderate-intensity aerobic-endurance/resistance exercise schedules have promoted repeatedly executive function, working memory attention, and memory skills/performances (Kujach et al., 2018; Salmoirago-Blotcher et al., 2018), although, alarmingly, most efforts have directed towards male performance [35]. Differential performance by male and female participants during both selective attention and memory tasks [36-38], showing no differences [39], or with women performing at a higher level than men reliably on measures of recognition memory performance that consisted also those
measures that assessed the remembrance of faces and a Neuropsychological Assessment Battery [40,41]. Effects upon emotional such as for example, emotional effects on recognition memory have been distinguished by middle childhood and remain consistent throughout adolescence and early adulthood for both girls and women, whereas emotion elicitation and emotional memory enhancement influences diminish slightly over age for boys and men [42]. Mental rotation tasks are measured as the length of time required for an individual to detect whether or not a stimulus matches another stimulus through mental rotation, a form of ‘strategy-shifting’; It has become evident that female participants are generally superior in their performance [43-46].

Considerations of exercise benefits for cognition in its most universal aspects ought to, of necessity, cater for (i) the type of targeted exercise training and program, (ii) the determinants of individual variation, that refer to biological, sex and genotypic factors, and (iii) the mechanisms through which exercise exerts its multi-layered influence on the brain, its structure and function [47], and not least the mobilization of synaptic proteins [48]. A meta-analysis investigation concerning long-lasting aerobic exercise interventions with middle-aged and older adults similarly observed that those studies retaining higher proportions of female participants presented stronger effects of intervention upon executive functions and brain-derived neurotrophic factor levels among older adults with subcortical ischemic vascular cognitive impairment but no differences in effect sizes for memory performance [49,50]. In a study of the role of ‘post-learning’ exercise on retention/consolidation, require neuro-modulatory factors such as dopamine, noradrenaline, and BDNF, of a task (picture-location associations followed by re-test), the participants carried out 35 minutes, Immediate delay, of physical exercise (5-min warm-up followed by increased exercise intensity to 80% of maximal heart rate) either immediately afterwards or 4h afterwards, prolonged delay [51]. Participants experiencing prolonged delay exercised 4h after encoding displayed enhanced memory relative to those who were non-exercised, whereas those who exercised immediately afterwards did not. The greater benefits of prolonged delay exercise seems counter-predictive to established consolidation notions and it was implied that neural processes immediately after encoding were already optimal for learning such that they could not be enhanced further through exercise mediation. Later, it was shown, in three different experiments, that the ‘Van Dongen effect’ was enhanced among female participants in comparison with their male counterparts concurrent with enhanced heart rate. These observations confirm the evidence from recognition memory task performance among female participants, compared to males, receiving moderate-intense exercise (rope-jumping-walking) as intervention [52]. In studies of episodic memory function it has been observed that acute moderate-intensity exercise immediately before the memory encoding process optimally enhances short-term and long-term memory functioning in comparison with a no exercise condition or in conditions of exercise during and after memory encoding [53]. Both chronic and a single bout of resistance exercise applied immediately after a fear conditioning memory testing procedure are sufficient to induce/improve contextual memory, probably through the activation of pre- and post-synaptic machinery required for memory consolidation [54,55].

Conclusions

Despite the apparent paucity of sufficiently comprehensive comparisons between cognitive performance on the wide array of learning and memory tasks available of younger and older females and males, particularly those associated with physical exercise interventions, there is much evidence to support all three outcomes,
i.e. (i) males > females, (ii) males and females not differing, and (iii) females > males, of which the final outcome, as exemplified through the ‘van Dongen’, effect is most germane to the present account. One tentative conclusion to be considered from that account, based on the premise that physical exercise, presented in optimal contiguity to the encoding procedure, promotes a sufficiency and necessity of memory consolidation; the above findings imply that the female participants in the ‘van Dongen’ effect were disposed towards greater mobilizations of biomarkers and synaptic proteins, bolstered by physical exercise schedules, in proximity to the contingency of consolidation; a critical test of this notion would be: the greater the intensity of exercise, the greater the preponderance of the outcome women > men.

Bibliography


