Chapter – 7

DISCUSSION

7.0 DISCUSSION:

There was a significant increase in attention, mental speed and working memory assessed using SLCT and DLST scores in yoga group compared to physical exercise group following intervention. There was a 23.9% increase in SLCT with yoga compared to 16.1% with physical training group. There was a 16.3% increase in DLST with yoga compared to 10.3% in physical training group. However, for measures of strength on hand grip, standing broad jump, back and leg dynamometer, improvements were equivocal following intervention in both groups. Even the flamingo balance scores showed similar improvements with both the interventions. However, spinal flexibility improved significantly in yoga group compared to physical exercise group. There was an increase in flexibility scores by 6.47 % in yoga compared to 3.09% in the control group.

The results from this study suggest that both yoga and physical exercise improved aerobic capacity in young adolescent children. There was a 5.3% increase in aerobic capacity with yoga compared to 4.1% with physical exercise. There was 8.5% increase in distance in physical exercise compared to 11.4% in yoga group. There was a 3.9% increase in Mets in physical exercise compared to 5.2% increase in Mets in Yoga group. There were no significant differences between yoga and physical exercise with respect to cardio-respiratory fitness. However, in those with an above median cut-off of VO2 max at baseline there was a significant improvement in VO2 max following yoga compared to physical exercise intervention suggesting yoga to improve VO2 max in those who have less aerobic capacity.

Results suggest yoga to be as good as physical exercise in improving strength, balance, endurance, aerobic power and speed. However, there was better improvement in spinal flexibility scores in yoga group that may be attributed to stretching and isometric components of yoga postures. Improvement in mental speed, attention, working memory could be due to increased internal awareness and relaxation conferred by yoga postures.

The results from this study suggest that both yoga and physical training improved memory and attention span in young adolescent children. The effect sizes seen with our intervention were small (-0.43 to -0.16) for SLCT and (-0.48 to -0.21) for DLST unlike previous studies that have shown large effect sizes (~1) with the above measures following yoga intervention in smaller sample populations. (Gothe & McAuley, 2015; Joshi & Telles, 2008; Sarang & Telles, 2007; Telles, Raghuraj, Maharana, & Nagendra, 2007).The results from this study are more robust as they can be generalized to the population due to coverage of a larger geographical area and larger sample size unlike the above pilot studies that are limited to a single school or a class. This also explains the overestimation of effect seen with yoga intervention in earlier studies as the delivery of intervention could have been more focused and intense that would not have been feasible in a large field population. Secondly, the physical exercise intervention was a structured intervention program imparted by Physical education teachers who were trained on the module. This could also explain the small to modest effect seen with the intervention as physical exercise also seemed to improve these domains which makes the results of this study more significant due to a larger sample size.

The findings of this study do not accurately reflect maximal aerobic power as the aerobic power or maximal oxygen uptake was recorded using a sub maximal exercise using a field test as compared to maximal exercise in a laboratory setting. However, the findings of the study reveal that other indices of cardio-respiratory fitness such as endurance (speed and distance), stamina (fatigability), etc. that clinically reflect cardio-respiratory fitness also improved with yoga and physical exercise intervention. The modest incremental improvement in this cardio-respiratory fitness could be because of breath training during postures (asana) and pranayama (regulated nostril breathing) that those in the yoga group were subjected to. Our findings are similar to earlier observations that have shown only 5% increment in aerobic capacity following aerobic exercise training in children. This is the maximum improvement in aerobic capacity seen following aerobic training in children compared to that of adults (Armstrong & Welsman, 1994). The effects were

not merely statistically significant but could have also been clinically significant considering confidence intervals and application of results to clinical child hood populations such as exercise induced asthma etc.

This study was carried out in schools spread over several districts in rural South India where protein energy malnutrition and anemia are widely prevalent. This study was done in schools where mid-day meals were provided by the government to tackle malnutrition among school going children. Improvement of cardio-respiratory performance among children suggests yoga is a feasible intervention in improving aerobic fitness and performance that reflects health status of the children (Stone, Rowlands, Middlebrooke, Jawis, & Eston, 2009). The findings of this study are important given the fact that this study was done in rural settings where education infrastructure is relatively poor compared to their urban counterparts. Further, earlier studies have shown that ventilation and carbon dioxide output were significantly higher in those practicing Suryanamaskar compared to bicycle exercise at maximum intensity of VO2 max indicating that Suryanamaskar imposed less cardio-respiratory stress than bicycle exercise. Our yoga program could have also facilitated less cardio-respiratory stress than exercise as seen in earlier studies (Sinha, Sinha, Pathak, & Tomer, 2013). This is particularly important as exercise could induce cardio-respiratory stress in those with anemia and malnutrition (Shouval et al., 2017). Yoga could therefore be a better intervention than exercise if we consider this setting; however, studies are needed to test this hypothesis in these settings. This study validates the feasibility and importance of physical exercise training and yoga in school children. That, teachers of these schools underwent training to impart and teach yoga to children makes yoga a feasible intervention to adopt in schools along with physical training. However, unlike the popular perception that Yoga is not an aerobic training, the results suggest otherwise.

Meta analytic studies have shown that aerobic training and improvement in aerobic capacity is associated with modest improvements in attention and processing speed, executive function, and

memory, although the effects of exercise on working memory are less consistent. This is similar to earlier meta-analytic reviews of randomized controlled trials (RCTs) that have shown variation in neuro-cognitive function associated with aerobic exercise(Angevaren, Aufdemkampe, Verhaar, Aleman, & Vanhees, 2008; Heyn, Abreu, & Ottenbacher, 2004; van Uffelen, Chin A Paw, Hopman-Rock, & van Mechelen, 2008), or those that show moderate cognitive gains (Colcombe & Kramer, 2003; Heyn et al., 2004)or modest improvements (Angevaren et al., 2008; Etnier, Nowell, Landers, & Sibley, 2006; Etnier et al., 1997).

Sedentary activity and Obesity in childhood has been shown to lead to development of diabetes. Childhood physical training has been shown to have a positive correlation with health and well-being in adulthood (Hallal, Victora, Azevedo, & Wells, 2006; Janz, Dawson, & Mahoney, 2000; Lotan, Merrick, & Carmeli, 2005), in part because of the development and maintenance of good health behaviors. Studies have suggested that physical training can decrease the symptoms of ADHD (Kiluk, Weden, & Culotta, 2009; Tantillo, Kesick, Hynd, & Dishman, 2002) and asthma (Moreau, Kalaboka, Choquet, & Annesi-Maesano, 2009; Nystad, Nafstad, & Harris, 2001; Priftis et al., 2007; Vlaski, Stavric, Seckova, Kimovska, & Isjanovska, 2008) in children. These findings validate the improvement in aerobic capacity and cognitive functions seen with yoga and physical exercise in our study.