CHAPTER-II  

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

The literature forms the foundation upon which all future work will be built. “The review of literature is generally used as a basis for inductive reasoning for locating and synthesizing all the relevant literature on particular topic”. A study of relevant literature is an inevitable and essential step to get full picture of what has been done with regard to the problem under study. Such a review brings perspective of the overall field. The literature in any field forms the foundation upon which all future work will be built. If we fail to build upon the foundation of knowledge provided by the review of literature, the researcher might miss some works already done on the same topic. The investigator has traced out different types of research works like dissertations, thesis, journals, relevant studies, varieties of relevant books on physical education and sports sciences.

A study of relevant literature is an essential step to get a full picture of what has been done with regard to the problem under study. Such a review brings about a deep and clear perspective of the overall field. The research scholar fixed his limits and made sincere efforts to locate and collect the literature relevant to the study. A study relevant literature is an essential step to
get a good comprehension of what has been done with regard to the problem under the study. The research scholar could locate and collect from the different library sources. Such a review will bring in a new insight and will the devolvement of research procedure. The research scholar had come across several books, periodicals, journals and unpublished thesis, while searching for relevant to this present study. Such of those facts are given below for a better understanding and to justify the study.

A study of the relevant literature is an essential step to get a complete picture of what has been done and said with regard to the problem under study, such a review brings about a deep insight and a clear perspective of the overall field. The review provides us with an opportunity of gaining right into the methods, measures, subjects and approaches employed by other research workers. Study of related literatures implies locating reading evaluating reports of research as well as reports of casual observation and opinion that are related to the individual planned research work.

2.2 STUDIES RELATED TO OBESITY

Goyal et al. (2011) \(^1\) found the “determinants of Overweight and Obesity in Affluent Adolescent in Surat City, South Gujarat region.” The purpose of this study was to determine risk factors for overweight and obesity among affluent

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adolescent, in Surat city in south Gujarat. Cross sectional from July 2009 to April 2010. Two private schools with tuition fees more than Rs. 2000 per month, were selected randomly using a random table. The participants were adolescents, 12 to 15 years of age. Data Pre-designed and pre-tested questionnaire was used to elicit the information about dietary history and physical activity. Height and weight was measured and BMI was calculated. Overweight and obesity were assessed by BMI for age. Student who had BMI for age >85th and <95th percentile of reference population were classified as overweight and BMI for age >95th percentile of reference population were classified as obese (IAP Growth Monitoring Guidelines for Children from Birth to 18 Year). The overall prevalence of obesity and overweight was 6.55% and 13.9% (boys: 6.7% and 15.1%; girls 6.4% and 13.35%). Final model of multiple logistic regression analysis showed that important determinants of overweight and obesity were low levels of physical activity, watching television or playing computer games, and consuming junk foods, snacks and carbonated drinks. It concludes that the magnitude of obesity and overweight among affluent adolescent of Surat city was found to be 6.55% and 13.9% respectively. The study implicated that low level of physical activity, watching TV or playing computer games, and dietary pattern predisposed the adolescent to overweight/obesity.
Manios et al. (2011)\textsuperscript{2} studied and aimed to estimate the prevalence of overweight and obesity and investigate associated factors in a representative sample of Cretan school children. As part of a cross-sectional study in children aged 10–12 years (n = 481, 48\% boys) in 27 (urban and rural) schools in Crete, Greece, the rates of overweight and obesity were estimated and multiple logistic regression was used to explore the relationship between several factors and body mass index (BMI). It was shown that 28\% and 13\% of children were overweight and obese, respectively. Factors affecting children's BMI classification included: gender (95\% CI: 0.21 to 0.56); birth weight (95\% CI: 1.33 to 3.46); parental overweight or obesity (95\% CI: 1.11 to 6.5 and 95\% CI: 4.37 to 30.7 for one and both overweight or obese parents, respectively), paternal educational level (95\% CI: 0.89 to 3.48 and 95\% CI: 1.49 to 6.13 for low and high educational level, respectively); and cardiovascular fitness levels (95\% CI: 0.87 to 0.92). The combined prevalence of overweight and obesity was alarmingly high in the current population (41\%); several physiological, behavioural and social factors were shown to affect children's BMI status. These findings highlight the extent of the child obesity problem in Crete and support the need for actions to be taken at a national level to tackle the obesity epidemic.

Wong et al. (2008)\textsuperscript{3} investigated the effective exercise programmes for the paediatric population is a strategy for decreasing obesity and is expected to help in eventually limiting obesity-associated long-term health and societal impact. In this study, the effects of a 12-week twice weekly additional exercise training, which comprised a combination of circuit-based resistance training and aerobic exercises, in additional to typical physical education sessions, on aerobic fitness, body composition and serum C-reactive protein (CRP) and lipids were analysed in 13- to 14-year-old obese boys contrasted with a control group. Both the exercise group (EG, n = 12) and control group (CG, n = 12) participated in the typical 2 sessions of 40-minute physical education (PE) per week in schools, but only EG participated in additional 2 sessions per week for 45 to 60 minutes per session of exercise training, which comprised a combination of circuit-based resistance training and aerobic exercises maintained at 65% to 85% maximum heart rate (HRmax = 220 - age). Body composition was measured using dual energy X-ray absorptiometry (DEXA). Fasting serum CRP and blood lipids was analysed pre- and post exercise programme. Aerobic fitness was measured by an objective laboratory sub maximal exercise test, PWC170 (Predicted Work Capacity at HR 170 bpm). Exercise training significantly improved lean muscle mass, body mass index, fitness, resting HR, systolic blood pressure and

triglycerides in EG. Serum CRP concentrations were elevated at baseline in both groups, but training did not result in a change in CRP levels. In the CG, body weight increased significantly at the end of the 12-week period. This study supports the value of an additional exercise training programme, beyond the typical twice weekly physical education classes, to produce physiological benefits in the management of obesity in adolescents, including prevention of weight gain.

Kamtsios and Digelidis (2008) examined the elementary school pupils with different body mass index (BMI) as to attitudes towards exercise, self-perception, lesson satisfaction in physical education and participation in physical activity. Seven hundred and seventy-five pupils participated in this study, aged 11-12 years. The study was conducted through questionnaires. Students were divided according to their BMI: normal, overweight and obese. Two-way analysis of variance was used, with gender and BMI type as independent variables. The results revealed that when compared to students with a normal BMI, the obese and overweight students had lower scores in lesson satisfaction, negative views of their body and reduced levels of physical activity. Also, the results showed that the obese and overweight students adopted more sedentary daily habits, such as many hours of TV watching and PC usage. The results of

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this study imply the need for necessary school interventions in order to encourage healthier behaviors and habits.

Pinhas et al. (2007)\(^5\) investigated the lipid profile and insulin changes seen in obese children and adolescents at different stages of puberty. A cross-sectional study was conducted by chart review of 181 obese (BMI > 95th) children and adolescents 5 to 17 years of age, who was referred to the Center for Atherosclerosis Prevention for cardiovascular risk reduction from January 2003 through December 2003. Eighty (44.2%) subjects were <12 years of age, and 101 (55.8%) were ≥12 years. Severity of obesity as expressed by BMI standard deviation score did not differ between these age groups. A significant difference with lower serum levels of total cholesterol, non-high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol was seen with older age and with advancing sexual maturity ratings. Triglycerides, very-low-density lipoprotein cholesterol, and lipoprotein (a) levels remained elevated across age and pubertal stages. Insulin levels and insulin resistance as expressed by homeostasis model assessment were significantly higher with older age. Similar trends were observed both in obese boys and obese girls during puberty. The most striking findings of this study are that in the 5- to 17-year-old obese population, the combination of elevated triglycerides and very-low-density lipoprotein cholesterol and low high-density lipoprotein

cholesterol levels place them at greater cardiovascular risk than their non-obese peers, even when the changing patterns of lipids and lipoproteins seen during pubertal maturation are accounted for.

**Maffeis and Castellani (2007)**\(^6\) Conducted the Physical activity is the only component of total energy expenditure that can be voluntarily modified. Therefore, it is a reasonable behavioural target for the prevention and treatment of obesity. Most of the fat oxidized daily in the body occurs in skeletal muscle. Physical activity increases the amount of oxidized fat, which helps control fat mass. Moreover, skeletal muscle is efficient blood glucose utilizes, and regular physical activity promotes insulin sensitivity and glucose homeostasis independently of its effect on body fat. The primary purpose of this study was to provide further insight into the metabolic effects of physical activity, especially in the regulation of energy expenditure, substrate oxidation and body composition. Also of interest is the analysis of available evidence that justifies the recommendation of physical activity programs in the treatment of childhood obesity.

Bell et al. (2007) conducted the number of obese children with insulin resistance and type 2 diabetes is increasing, but the best management strategy is not clear. The objective of this study was to assess the effect of a structured 8-week exercise training program on insulin resistance and changes in body composition in obese children. The study was 8 weeks of structured supervised exercise intervention with outcome measures before and after the exercise period. Fourteen obese children (12.70 ± 2.32 yr; eight male, six female) with high fasting insulin levels were enrolled into the study. Intervention consisted of 8 weeks of supervised circuit-based exercise training, composed of three fully supervised 1-h sessions per week. Outcome measures were assessed pertaining program and post training program and included insulin sensitivity (euglycemic-hyperinsulinemic clamp studies), fasting insulin and glucose levels, body composition using dual energy x-ray absorptiometry scan, lipid profile, and liver function tests. Insulin sensitivity improved significantly after 8 weeks of training (Mlbm 8.20 ± 3.44 to 10.03 ± 4.33 mg/kg·min, P < 0.05). Sub maximal exercise heart rate responses were significantly lower following the training (P < 0.05), indicating an improvement in cardiorespiratory fitness. Dual energy x-ray absorptiometry scans revealed no differences in lean body mass or abdominal fat mass. A 8-week exercise training program increases insulin sensitivity in obese children.
children, and this improvement occurred in the presence of increased cardiorespiratory fitness but is independent of measurable changes in body composition.

Butte et al. (2007) explored despite the high prevalence of childhood obesity among U.S. Hispanic children and adolescents, quantitative, objective data on their patterns and levels of physical activity are scarce. To describe qualitatively the types of physical activities in which nonoverweight and overweight Hispanic children and adolescents participate; 2) to use the accelerometer to quantitatively describe the duration, intensity, and frequency of physical activity; 3) to examine the influence of age, gender, and BMI status on physical activity levels; and 4) to determine the relationships between physical activity and adiposity, fitness, and risk for the metabolic syndrome. Cross-sectional assessment of physical activity using accelerometers was made for three continuous days in 897 nonoverweight and overweight Hispanic children; ages 4-19 yr. Ancillary measurements included blood pressure, anthropometry, body composition by dual-energy x-ray absorptiometry, fitness by VO_{2peak} test, and metabolic risk factors, using standard clinical and biochemical methods. Types and levels of physical activity were influenced by age, gender, and body mass index (BMI) status. Total physical activity counts declined markedly with increasing age (P = 0.001) and were consistently higher in boys than in girls (P =

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0.001). Total activity counts were lower ($P = 0.002$) and sedentary activity counts were higher in overweight than in nonoverweight children ($P = 0.001$). Sleep duration ($\text{min·d}^{-1}$) was slightly lower in overweight compared with nonoverweight children, ages 4-8 yr ($P = 0.03$). Physical activity levels were significantly associated with percent FM, $V\dot{O}_{2\text{peak}}$, fasting serum insulin, and waist circumference, although the strength of the associations were generally low. Efforts should be made to shift the time in sedentary activity to light activity, and to increase the time spent in moderate to vigorous activity in U.S. Hispanic children and adolescents, with special attention given to the overweight, girls, and adolescents.

Amanda et al. (2007) studied the rising prevalence of obesity in children and an adolescent is implicated in the metabolic abnormalities that track into adulthood. The associated increased incidence of insulin resistance, metabolic syndrome and type two diabetes being identified in younger cohorts has given rise to a critical global health issue. Muscular strength is a vital component of metabolic fitness that provides protection from insulin resistance in adults, and they have recently shown this to be true in children as well. Targeting muscular strength deficiencies at an early age may be an effective preventative strategy for metabolic syndrome and type two diabetes. There is limited evidence-based best practice for progressive resistance training (PRT),

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adiposity and metabolic fitness in children and adolescents. The purpose of this research is to describe the methodology they utilized for implementing a PRT program to avoid publication bias, enable replication of the study and share a novel program that they have found safe and suitable for use with youth. They conducted the first randomized controlled trial (RCT) prescribing high-intensity PRT to children and adolescents (10–15 years) as a community-based primary prevention program to address adiposity and metabolic health. Participants were instructed to complete 2 sets of 8 repetitions of 11 exercises targeting all the major muscle groups twice a week at an RPE of 15–18 for 8 weeks. The primary outcome was waist circumference; secondary outcomes included insulin resistance, lipid levels, muscle strength, cardio respiratory fitness, body composition, self-efficacy, self-concept, habitual physical activity, nutrition and sedentary behaviour patterns. The supervised PRT program that they used with children and adolescents has been described in detail. The efficacy of this modality of exercise for metabolic fitness and other health outcomes is now under investigation.

Magkos et al. (2006)\(^{10}\) examined Risk factors for heart diseases are becoming increasingly prevalent among younger populations. The aim of this study was to assess the cardiovascular risk profile of young adolescents living in

a semi-rural area of mainland Greece, Volos. A total of 198 children (106 females and 92 males) aged 11.6 ± 0.4 years were randomly recruited. Mean body mass index was 20.4 ± 3.5 kg m$^{-2}$, while 30.3% of children were overweight and 6.7% were obese; no differences were observed between boys and girls. Mean plasma cholesterol (4.93 ± 0.75 mmol L$^{-1}$), low-density lipoprotein-cholesterol (3.29 ± 0.64 mmol L$^{-1}$) and triglyceride (0.97 ± 0.31 mmol L$^{-1}$) concentrations were above age-specific recommended values.

On the other hand, mean high-density lipoprotein-cholesterol was accepted for 92.3% of the children. Self-reported daily energy intake (8.37 ± 3.06 MJ) was adequate for an age, but intake of fat was high (42.0 ± 9.2% of energy) and that of carbohydrates was relatively low (44.5 ± 10.0% of energy). Saturated fat consumption was elevated (15.6 ± 4.3% of energy), while polyunsaturated fat intake fell short (4.8 ± 1.6% of energy). The study participants spent 9.60 ± 6.44 h week$^{-1}$ on moderate to vigorous physical activities, while they devoted 16.60 ± 8.81 h week$^{-1}$ to sedentary activities. Boys spent significantly more time than girls on both physical ($P < 0.001$) and sedentary ($P = 0.001$) activities. No major gender differences were observed in anthropometric, dietary and plasma lipid parameters. The findings from the present study support the worrisome trends that have been documented in Greek youngsters elsewhere, and predict an unfavourable cardiovascular risk profile of the Greek population in the foreseeable future.
Janet et al. (2006)\textsuperscript{11} studied the variation in the psychological distress associated with child obesity. Low self-esteem, when observed, provides very little information about the nature of the distress and no indication of the proportion of obese children affected. This study used a domain approach to self-competence to evaluate self-esteem in a representative sample of Australian children. A total of 2813 children (mean age: 11.3 years) took part in the study. They were recruited from 55 schools and were all in the last 2 years of primary school. Participants completed the Self-perception Profile for Children, a measure of body shape perception, and their height and weight were measured. Obese children had significantly lower perceived athletic competence, physical appearance, and global self-worth than their normal weight peers. Obese girls scored lower in these domains than obese boys and also had reduced perceived social acceptance. Obese children were 2–4 times more likely than their normal weight peers to have low domain competence. In terms of prevalence, 1 of 3 obese boy and 2 of 3 obese girls had low appearance competence, and 10\% and 20\%, respectively, had low global self-worth. Body dissatisfaction mediated most of the association between BMI and low competence in boys but not in girls. Obesity impacts the self-perception of children entering adolescence, especially in girls, but in selected areas of competence. Obese children are at particular risk of low perceived competence in sports, physical appearance, and

peer engagement. Not all obese children are affected, although the reasons for their resilience are unclear. Quantifying risk of psychological distress alongside biomedical risk should help in arguing for more resources in child obesity treatment.

**Deforche, DeBourdeaudhuij and Tanghe (2006)** investigated the differences in physical activity and attitude toward physical activity in adolescents with different degrees of overweight and explore whether the prediction of physical activity by the attitude is moderated by level of overweight. Subjects were divided into a normal-weight group (n = 37, 18.8 ± 1.2 kg/m$^2$), an overweight group (n = 28, 25.9 ± 1.3 kg/m$^2$), and an obese group (n = 24, 33.7 ± 4.1 kg/m$^2$). Mean age was 14.6 ± 1.2 years, with 72% girls. Physical activity was estimated using the Baecke Questionnaire. Attitude was measured by assessing perceived benefits and barriers. Participation in sports was higher in normal-weight compared with overweight ($p < .05$) and obese ($p < .01$) Subjects. There was no difference in leisure-time physical activity between the groups. Perceived benefits did not differ between groups, but normal-weight subjects perceived fewer barriers (‘physical complaints’, ‘not being good at it’, ‘insecure about the appearance’, ‘not liking it’) than their overweight ($p < .05$) And obese ($p < .001$) Counterparts. Obese adolescents had a less positive attitude compared with their normal-weight ($p < .001$) and overweight ($p < .05$

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Peers. Sport participation was significantly predicted by the perceived benefit ‘pleasure’ \((p < .05)\) and by the perceived barrier ‘not liking it’ \((p < .001)\), after taking into account the level of overweight. The association between sport participation and attitude was not moderated by level of overweight. This study demonstrates that overweight and obese adolescents show lower sport participation and have a less positive attitude toward physical activity. Interventions in youngsters with weight problems should try to increase participation in sports by making activities more fun and attractive to these youngsters.

**Atlantis, Barnes and Singh (2006)**\(^{13}\) investigated the overweight prevalence among children/adolescents is increasing, while adult obesity may potentially cause a decline in life expectancy. More exercise is uniformly recommended, although treatment efficacy remains unclear. To determine the efficacy of exercise alone for treating overweight in children/adolescents. A systematic review and meta-analysis of randomized trials published in English were completed following multiple database searches performed on December 10, 2004. Studies of isolated or adjunctive exercise/physical activity treatment in overweight/obese children or adolescents which reported any overweight outcome were included. Literature searches identified 645 papers which were manually searched, of which 45 were considered for inclusion, of which 13

papers which reported 14 studies were included (N=481 overweight boys and girls, aged 12 years). Two reviewers independently identified relevant papers for potential inclusion and assessed methodological quality. Principal measures of effects included the mean difference (MD) (between treatment and control groups), the weighted MD (WMD), and the standardized MD (SMD). Few studies were of robust design. The pooled SMD was -0.4 (-0.7, -0.1, P=0.006) For percent body fat, and -0.2 (-0.6, 0.1, P=0.07) For central obesity outcomes, whereas the pooled WMD was -2.7 kg (-6.1 kg, 0.8 kg, P=0.07) For body weight, all of which favoured exercise. Pooled effects on body weight were significant and larger for studies of higher doses, whereas no significant and smaller effects were seen in studies of lower doses of exercise (155–180 min/weeks vs 120–150 min/weeks). Based on the small number of short-term randomized trials currently available, an aerobic exercise prescription of 155–180 min/weeks at moderate-to-high intensity is effective for reducing body fat in overweight children/adolescents, but effects on body weight and central obesity are inconclusive.

**Wareham, Sluijs and Ekelund (2005)**

studied the Ecological data on temporal trends suggest that the rising prevalence of obesity is, at least in part, attributable to declining population energy expenditure. However, population-level data on trends in physical activity are scarce. In longitudinal cohort studies

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individuals who report higher levels of leisure-time physical activity tend to be less likely to gain weight, but studies vary in their conclusions because of issues of confounding, reverse causality and measurement error. The majority of studies suggest that low levels of activity are only weakly associated with future weight gain. Questions about dose–response can only be properly addressed by studies including objective measures of activity with known measurement error. The observational studies leave uncertainties about the direction of causality, as individuals who are overweight are less likely to stay active. Adjustment for confounding can diminish the impact of known confounders, but only randomization can deal with issues of unmeasured confounding. Although there are a large number of clinical trials on the treatment of individuals with obesity or the prevention of weight regain among weight losers, the updated review of trials to prevent weight gain only reveals six trials published since 2000 in adults and eleven in children. Not only are these trials relatively few in number but, for various methodological reasons, they are uncertain in their conclusions about whether the increasing activity will be effective in preventing obesity. Whilst efforts should continue to enhance the evidence base it is wise, in the meantime, to stick to the consensus public health advice of advocating 45–60 min moderate intensity activity daily to prevent obesity.
Katie et al. (2005)\textsuperscript{15} Explored the childhood obesity has reached epidemic proportions worldwide and is associated with increased cardiovascular mortality and morbidity in adult life. The increase in fat mass in children and adolescents has occurred concomitantly with a decline in reported time for exercise. Evidence suggests that non-physically active children are more likely to become non-physically active adults and that encouraging the development of physical activity habits in children helps establish patterns that continue into adulthood. Dietary treatment of obesity is relatively ineffective in adults and it has been suggested that prevention of obesity in childhood and adolescence should emphasise increased physical activity rather than diet because of fears relating to the adverse effects of inappropriate eating patterns. Despite this, there are very few randomised controlled studies investigating the efficacy of exercise training in obese children or adolescents and many of the extant studies have been poorly controlled and have not specifically stratified the independent effect of exercise versus dietary modification. This review focuses on the well designed controlled trials that have evaluated the effect of exercise training in obese children and adolescents on body composition, hemodynamic and metabolic variables, cardiovascular fitness, muscular strength and vascular function. These studies indicate that, although exercise training does not consistently decrease body weight or body mass index, it is associated with

beneficial changes in fat and lean body mass, emphasising the importance of comprehensive assessment of body composition in future exercise-training studies. Exercise training improves cardiovascular fitness and muscular strength; however, it seems to have little effect on blood lipid profile or blood pressure in obese young people. Importantly, recent studies have demonstrated that exercise training improves vascular endothelial function, an important surrogate measure that may predict future atherosclerotic risk in obese children and adolescents. Given that improvement in vascular function in these training studies occurred in the absence of changes in lipid fractions, haemodynamic variables or glucose metabolism, exercise appears to have a direct beneficial effect on the vascular, in addition to its putative benefits through risk-factor modification.

Watts (2004)\textsuperscript{16} explored the atherosclerosis is a disease that begins in childhood endothelial dysfunction is its earliest detectable manifestation, and primary prevention strategies are likely to be most effective if instituted early. The aim of this study was to characterize the impact of obesity on vascular function in young children and to determine whether an exercise program improves abnormalities in vascular function. The influence of 8 weeks of exercise training was examined in 14 obese subjects, 8.9 ± 0.4 years of age, with the use of a randomized crossover protocol. Conduit vessel endothelial function was assessed by means of high-resolution ultrasound and flow-mediated dilation.

of the brachial artery (FMD). Exercise training did not change subcutaneous fat mass, body weight, or body mass index. FMD in the obese group was significantly impaired relative to matched control subjects at entry (6.00% ± 0.69% to 12.32% ± 3.14%, \( P < .0001 \)). FMD significantly improved with exercise training (7.35% ± 0.99%, \( P < .05 \)) in the obese group. Conduit vessel FMD, a validated surrogate measure of early atherosclerosis, was impaired in obese children but improved as a result of exercise training. This study supports the value of an exercise program in the treatment of obese children in a primary prevention setting.

Sothern (2004)\(^\text{17}\) studied the current environmental experience of young children includes few opportunities for physical activity and an overabundance of high calorie foods. Sedentary lifestyles and poor nutrition challenge children who are predisposed to metabolic disorders. Obesity is a logical response to this challenge. To prevent clinically significant obesity and later metabolic disease in predisposed youth, all sectors of society must work together to support strategies to change public opinion and behavior across the life span. Parental education in all medical settings is strongly recommended, especially if the parent(s) are obese, beginning with the first pregnancy visit to the physician. Schools should be primary targets for efforts to educate parents concerning the reduction of TV, computer games, and unhealthy snacks. Schools should be encouraged to adopt

vending machine policies that promote healthy drinks and food in appropriate portion sizes and discouraged from providing unhealthy food as rewards for positive behavior or academic accomplishment. Schools should provide daily physical education and frequent periods of unstructured play in young children. Clinical treatment should be both encouraged and financially supported in children who are already overweight. Community wide efforts to increase awareness and promote environments that encourage physical activity and healthy nutrition are needed.

**Chhatwal, Verma and Riar (2004)** studied on Obesity among Pre-Adolescent and Adolescents of a Developing Country (India). There are very few reports from the developing world on the prevalence of obesity among children even though in developed countries it has reached epidemic proportions. The objective of this study was to determine the prevalence of obesity in pre-adolescent and adolescent children in a developing country (India) using WHO guidelines for defining obesity and overweight. This cross-sectional study was carried out on 2008 school-children aged 9-15 years. Approximately half the subjects belonged to a school attended by children of well to do families while the rest belonged to two schools from middle and lower socio-economic background. Weight and height were taken for all children and the body mass index (BMI) calculated. Children whose BMI was >85th percentile for age and

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sex were defined as overweight. Triceps skin fold thickness (TSFT) was measured for all overweight children and those with TSFT >90th percentile for age and sex were defined as obese. The overall prevalence of obesity and overweight was 11.1% and 14.2% respectively. The prevalence of obesity as well as overweight was higher in boys as compared to girls (12.4% vs 9.9%, 15.7% vs 12.9%). Prevalence of obesity decreased significantly with age, from 18.5% at 9 years to 7.6% at 14 years, rising at 15 years to 12.1%. Significantly more children from higher socio-economic status were obese and overweight than those from lower socio-economic status groups. No significant gender difference for obesity prevalence was seen among children from a less privileged background, however, amongst children from affluent families, significantly more boys were obese as compared to girls. Pediatric obesity is an emerging problem in developing countries, especially among higher socio-economic status groups. Significant gender disparity is seen, with boys of affluent background having a higher prevalence.

Zabinski et al. (2003)\(^\text{19}\) examined as the epidemic of overweight increases among youth, research needs to examine factors that may influence children's participation in weight-related health behaviours. This study examined overweight children's perceived barriers to and support for physical activity compared with non overweight children. Barriers to and support for physical

activity were examined among 84 overweight children attending a summer fitness camp or a university-based weight loss clinic. Barriers and support levels were then compared with those of 80 non overweight children of a similar age range. Body-related barriers were the most predominant barrier types among overweight youth, especially among overweight girls. Overweight children, particularly girls, reported significantly higher body-related, resource, and social barriers to physical activity compared with non overweight children and lower levels of adult support for physical activity. Overweight children may be particularly vulnerable to body-related barriers to physical activity, and reducing such barriers may serve as physical activity intervention points most relevant for overweight youth. Future interventions may also benefit from enhancing support for physical activity from adults and peers.

Sztainer, Story and Hannan (2003) studied the feasibility of an innovative school-based program for obesity prevention among adolescent girls. New Moves were implemented as a multicomponent, girls-only, high-school physical education class. Six schools were equally randomized into intervention and control conditions. Data were collected at baseline, post intervention, and 8-month follow-up to assess program impact on physical activity, eating patterns, self-perceptions, and body mass index (BMI) among 89 girls in the intervention and 112 girls in the control conditions. Program evaluation also included

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interviews with school staff, parent surveys, and participant interviews and process evaluation surveys. The feasibility of implementing New Moves was high, as indicated by strong satisfaction among participants, parents, and school staff, and by program sustainability. Participants perceived a positive program impact on their physical activity, eating patterns, and self-image. Girls in the intervention significantly progressed in their stage of behavioural change for physical activity from baseline to follow-up. However, for the majority of outcome variables, differences between intervention and control schools at post intervention and follow-up were not statistically significant. New Moves were well received and fills a needed niche within school physical education programs. An expanded intervention and evaluation is needed to enhance and assess long-term program effectiveness.

Berkey et al. (2003)\textsuperscript{21} conducted the cross-sectional studies have suggested that children who were less physically active and children who watched more television had more excess body weight, but no large nationwide longitudinal studies have addressed whether children who change their personal levels of activity or inactivity, from one year to the next, experience changes in audacity. The objective was to study the association between change in body mass index (BMI) over 1 year and same year change in recreational physical

activity and change in recreational inactivity TV, videos, video games Design. A cohort study using data from 2 mailed questionnaires, 1 year apart. Participants. A total of 11 887 boys and girls aged 10 to 15, who returned questionnaires in both 1997 and 1998 as part of the Growing up Today Study. Outcome Measure. Change in BMI from 1997–1998, accounting for increases in BMI associated with growth and development. An increase in physical activity from 1997–1998 was associated with decreasing relative BMI in girls (−0.06 kg/m$^2$ per hour increase in daily activity; 95% confidence interval [CI]: −0.11, −0.01) and in overweight boys (−0.22 kg/m$^2$; CI: −0.33, −0.10). An increase in inactivity was associated with increasing BMI in girls (+0.05 kg/m$^2$ per hour increase in daily TV/videos/video games; CI: +0.02, +0.08). Effects were generally stronger among overweight children. Increasing time doing aerobics/dancing and walking were associated with BMI declines for some groups of children. Many children may benefit from increasing their physical activity and by reducing time watching TV or videos and playing video games. In particular, 2 activities accessible to most children, aerobics/dancing and walking, also appeared beneficial.

Gilles (2002)$^{22}$ Examined the obesity is rapidly becoming a major medical and public health problem, the aim of our study was to determine if obesity in Caucasian adolescents at 5 different Tanner stages are associated with

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$^{22}$ Gilles, Plourde. “Impact of Obesity on Glucose and Lipid Profiles in Adolescents at different Age Groups in Relation to Adulthood.” Research Article BMC Family Practice (October, 2002), Vol.3:1814
obesity in adulthood and its obesity-associated abnormal glucose and lipid profiles, the type of fat distribution is associated with glucose and lipid profile abnormalities, and the risk level and the age of appearance of these abnormalities. Data analyses were from a case-control study of adolescents classified according to their BMI; a BMI \( \geq 85^{\text{th}} \) percentile for age and sex as overweight, and those with a BMI \( \geq 95^{\text{th}} \) percentile as obese. Subjects with a BMI < 85\(^{\text{th}}\) percentile were classified as controls. WC:AC ratio of waist circumference to arm circumference was used as an indicator of a central pattern of adiposity. Two other indices of central adiposity were calculated from Skinfolds: Central-peripheral (CPR) as subscapular skinfold + suprailliac skinfold)/ (triceps skinfold + thigh skinfold) and ratio of subscapular to triceps skinfold (STR). The sum of the four Skinfolds (SUM) was calculated from triceps, subscapular, suprailliac and thigh Skinfolds. Representative adult subjects were used for comparison. Glucose and lipid profiles were also determined in these subjects. Abnormal glucose and lipid profiles were determined as being those with fasting glucose \( \geq 6.1 \) mmol/l and lipid values \( \geq 85^{\text{th}} \) percentile adjusted for age and sex, respectively. Prevalence and odds ratio analysis were used to determine the impact of obesity on glucose and lipid profiles at each Tanner stages for both sexes. Correlation coefficient analyses were used to determine the association between glucose and lipid profiles and anthropometric measurements for both sexes. The second study evaluated in a retrospective-prospective longitudinal way if obesity in adolescence is associated
with obesity in adulthood and the nature of obesity-associated risk factors. Incidence and odds ratio analysis were used to determine the impact of obesity on glucose and lipid profiles at 7 different age groups from 9 to 38 years old in both sexes between 1974 to 2000. Overall, glucose and lipid profiles were significantly \((P < 0.01)\) associated with all anthropometric measurements either in male and female adolescents. WC: AC, CPR, STR and SUM are stronger predictors of both glucose and lipid profiles than BMI. Obese and overweight adolescents of Tanner stages III and higher are at increased risk of having an impaired glucose and lipid profiles than normal subjects with odds ratios of 5.9 and higher. Obesity in adolescents of 13–15 years old group is significantly \((P < 0.01)\) associated with obesity in adulthood (with odds ratios of at least 12 for both men and women) and abnormal glucose (odds ratio of \(\geq 8.6\)) and lipid profiles (odds ratio of \(\geq 11.4\)). This study confirmed that adolescents aged between 13 and 15 years old of both sexes with a BMI \(\geq 85^{th}\) percentile are at increased risk of becoming overweight or obese adults and presenting abnormal glucose and lipid profiles as adults. This emphasizes the importance of early detection and intervention directed at treatment of obesity to avert the long-term consequences of obesity on the development of cardiovascular diseases.

**Baur (2002)**\(^{23}\) studied an early 21st century has seen the development of a global epidemic of obesity in both developed and developing countries. In

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Australia at least one in five children and adolescents are overweight or obese, with rapid rises in prevalence apparently continuing. Similar trends are seen in other countries. Child and adolescent obesity are associated with both immediate and long-term medical and psychosocial problems, including a clustering of risk factors for the development of cardiovascular disease and diabetes. Thus, obesity poses a major health problem for the pediatric population. Major environmental and societal changes have led to a decrease in physical activity, a rise in sedentary behaviour and the consumption of high fat and high-energy foods, all in turn influencing the development of obesity. Effective management involves a multimodal approach with a developmentally aware approach, involvement of the family, a focus on healthy food choices, incorporation of physical activity and a decrease in sedentary behaviour all being important. Ultimately, however, the obesity epidemic requires a major focus on primary prevention. Australia has a national strategy for the prevention of overweight and obesity that depends upon intersectoral and intergovernmental cooperation, supported by adequate resourcing and significant community ownership.

Winett and Carpinelli (2001) studied the public health guidelines primarily focus on the promotion of physical activity and steady-state aerobic exercise, which enhances cardiorespiratory fitness and has some impact on body composition. However, research demonstrates that resistance exercise training

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has profound effects on the musculoskeletal system, contributes to the maintenance of functional abilities, and prevents osteoporosis, sarcopenia, lower-back pain, and other disabilities. More recent seminal research demonstrates that resistance training may positively affect risk factors such as insulin resistance, resting metabolic rate, glucose metabolism, blood pressure, body fat, and gastrointestinal transit time, which are associated with diabetes, heart disease, and cancer. Research also indicates that virtually all the benefits of resistance training are likely to be obtained in two 15- to 20-min training sessions a week. Sensible resistance training involves precise controlled movements for each major muscle group and does not require the use of very heavy resistance. Along with brief prescriptive steady-state aerobic exercise, resistance training should be a central component of public health promotion programs.

Steinbeck (2001) investigated the prevalence of childhood obesity is increasing and there are a number of theoretical reasons as to why an intervention may be more effective in childhood. There are certain risk times for the development of obesity in childhood, which provide a basis for targeted intervention. In addition, tracking data supports the persistence of obesity, at least in later childhood, as well as cardiovascular risk factors. Physical activity is the discretionary component of energy expenditure and there is evidence that

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falling levels of physical activity are contributing to the obesity epidemic. Physical activity in children is related to developmental stage, is reduced with increasing age and is influenced by parental physical activity. While there is debate about the immediate health benefits of physical activity for children, there are data to support that lower physical activity levels and sedentary behaviors are associated with a higher prevalence of obesity in children. Physical activity is an accepted strategy in the treatment of established obesity (tertiary prevention). The role of physical activity in the prevention of obesity (primary and secondary prevention) is less clear. However a number of recent school-based interventions directed at either increasing physical activity and/or decreasing sedentary behaviors have shown encouraging results. On balance, increasing physical activity in children is an attractive and non-restrictive approach to obesity prevention. To adopt this approach requires the support and involvement of many community sectors other than health.

Deckelbaum and Williams (2001)  

Studied the overweight and obesity in children is epidemic in North America and internationally. Approximately 22 million children under 5 years of age are overweight across the world. In the United States, the number of overweight children and adolescents has doubled in the last two to three decades, and similar doubling rates are being observed worldwide, including in developing countries and regions where an increase in

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the Westernization of behavioural and dietary lifestyles is evident. Comorbidities associated with obesity and overweight are similar in children as in the adult population. Elevated blood pressure, dyslipidemia, and a higher prevalence of factors associated with insulin resistance and type 2 diabetes appear as frequent comorbidities in the overweight and obese pediatric population. In some populations, type 2 diabetes is now the dominant form of diabetes in children and adolescents. Disturbingly, obesity in childhood, particularly in adolescence, is a key predictor of obesity in adulthood. Moreover, morbidity and mortality in the adult population are increased in individuals who were overweight in adolescence, even if they lose the extra weight during adulthood. Although the cause of obesity in children is similar to that of adults (i.e., More energy in vs. Energy utilized), emerging data suggest associations between the influence of maternal and fetal factors during intrauterine growth and growth during the first year of life, at risk of later development of adult obesity and its commodities. In addition, recent data suggest that varying biological responses in different racial/ethnic groups differently contribute to overweight, obesity, and their commodities. Although differences in gene–nutrient interactions may contribute, the role of varying cultural and socioeconomic variables still need to be determined to understand these disparities. Novel approaches in the prevention and treatment of childhood overweight and obesity are urgently required. With the strong evidence that a lifecycle perspective is important in obesity development and its consequences, consideration must be focused on prevention
of obesity in women of childbearing age, excessive weight gain during pregnancy, and the role of breastfeeding in reducing later obesity in children and adults. Consideration must be given to family behaviour patterns, diet after weaning, and the use of new methods of information dissemination to help reduce the impact of childhood obesity worldwide.

Goran and Treuth (2001)\(^\text{27}\) explored the average 5-year-old child consumes close to a half-million calories per year. Despite this huge energy intake, most healthy children are able to strike a remarkable balance between energy intake, energy expenditure, and energy storage for growth through precise homeostatic regulation. This regulation of energy metabolism is achieved over the long term despite large fluctuations in energy intake and energy expenditure within and between days. The accuracy and precision by which the body regulates energy metabolism is highlighted by the fact that even a small error in the system can have detrimental consequences over time. If energy intake exceeds energy needs by as little as 105 kJ per day, then over time, a person will become obese. The achievement of overall energy balance is driven by the first law of thermodynamics, which states that energy can neither be destroyed nor created. This principle necessitates that, when energy intake equals energy expenditure, body energy stores must remain constant. In children, this process is complicated by additional energy needs for growth. Obesity is the

result of a mismatch between energy intake and energy needs, resulting in the net accumulation of energy stores in the body and the development of obesity.

_**Sothern (2001)**[^28] studied the prevalence of obesity in children and adolescents was higher than 20 years ago in all racial–ethnic, age, and sex groups. Evidence continues to support reduced physical activity and sedentary behaviour, such as television viewing, as primary causes of the current worldwide obesity epidemic. Several researchers have published results of programs that target decreases in sedentary behaviours as methods to increase physical activity and reduce obesity in children. It is possible that, for many children, increasing physical activity may be adequate to prevent the onset of childhood obesity. Because young animals, including humans, are inherently active, young children will be active if given encouragement and opportunity. Childhood activity is often intermittent and sporadic thus, children likely will not participate in prolonged exercise without rest periods; however, if given the opportunity, young children will perform relatively large volumes of intermittent, non structured physical activity. Generous periods of free play are recommended highly, together with frequent periods of adult-initiated moderate to vigorous activities, including the participation of parents and teachers. Encouraging active play as a means for increasing overall energy expenditure has been shown to be effective in reducing obesity in 5- to 8-year-

old girls. Providing safe environments for young children to play actively outdoors is essential to increasing the physical activity patterns of overweight children and those at risk for obesity. This provision may be accomplished only through policy changes, environmental planning, and school and community education efforts. Motivating young, nonobese, physically active children to maintain activity patterns may be less challenging than increasing patterns in already obese older children. Javernick suggests that just monitoring children during free play does not encourage the participation of heavier children. Heavier children often are ignored and ridiculed and often choose indoor, sedentary activities to escape negative activity situations. Therefore, encouraging sedentary, obese children participate in physical activity is difficult. In addition, even mildly overweight children have a decreased exercise tolerance; movement may be uncomfortable and, in some cases, painful. Structured and vigorous, aerobic-type activities when prescribed to overweight children, regardless of the individual's cognitive, physical, and emotional stage of development, may result in noncompliance or physical injury. Prior failure to motivate and maintain increased physical activity in overweight or obese children may be attributed to inappropriate exercise recommendations and a lack of physical opportunities for overweight children in the traditional school environment. In addition, emotional problems further may inhibit successful motivation of sedentary children.
Howley (2001) defined the essential terminology associated with dose-response issues in physical activity and health. Recent consensus documents, position stands, and reports were used to provide reference definitions and methods of classifying physical activity and exercise. The two principal categories of physical activity are occupational physical activity (OPA) and leisure-time physical activity (LTPA). OPA is usually referenced to an 8-h day, whereas the duration of LTPA is quite variable. LTPA includes all forms of aerobic activities, structured endurance exercise programs, resistance-training programs, and sports. Energy expenditure associated with aerobic activity can be expressed in absolute terms (kJ·min⁻¹), referenced to body mass (METs), or relative to some maximal physiological response (i.e., maximal heart rate (HR) or aerobic power (VO₂max)). The net cost of physical activity should be used to express energy expenditure relative to dose-response issues. The intensity of resistance training is presented in terms relative to the greatest weight that can be lifted one time in good form (1RM). The intensity of OPA followed the guidance of a previous consensus conference. The intensity of most LTPA can be categorized using the standard aerobic exercise classifications; however, for long-duration (2+ hours) LTPA, the classifications for OPA may be more appropriate. Physical activities should be classified in a consistent and

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standardized manner in terms of both energy expenditure and the relative effort required.

Guerra, Duarte and Mota (2001)\textsuperscript{30} studied to provide descriptive data about various CVD risk factors (triglycerides [TG], total cholesterol [TC], blood pressure and physical activity patterns) among schoolchildren in a specific sample; (ii) to document the extent to which physical activity is associated with variations in CVD risk factors among schoolchildren. The study comprised 474 children (242 males and 232 females, aged 8–13 years) selected in the Porto area of Portugal. The multiple regression analysis showed that the physical activity index is not associated with the variation in the biological risk factors in girls, while for boys a significant association was found for systolic blood pressure (R\textsuperscript{2} = .04, \(p = .05\)) and diastolic blood pressure (R\textsuperscript{2} = .03, \(p = .05\)). The present study shows that boys were significantly more active than girls, except for the young group (8–9 years old). However, except for SBP and DBP in males, no significant benefit from physical activity was related to the CVD risk factors evaluated. Since girls consistently reduce their levels of physical activity, some further attention should be given to this matter, mainly in the context of physical activity at school.

\textsuperscript{30} Guerra Sandra; Duarte Jose and Mota Jorge. “Physical Activity and Cardiovascular Disease Risk Factors in Schoolchildren.” European Physical Education Review (October 2001) Vol. 7(3) : 269-281.
Tolfrey, Jones and Campbell (2000)\textsuperscript{31} studied the longitudinal paediatric population studies have provided evidence that the risk factor theory may be extended to children and adolescents. These studies could assist in identifying individuals at increased coronary risk. Numerous studies have focused on the effects of regular exercise on the pediatric lipoprotein profile, a recognised primary risk factor, with equivocal results. Cross-sectional comparisons of dichotomised groups provide the strongest evidence of an exercise effect. ‘Trained’ or ‘active’ children and adolescents demonstrate ‘favourable’ levels of high density lipoprotein-cholesterol (HDL-C), triacylglycerol, total cholesterol (TC) /HDL-C and low density lipoprotein-cholesterol (LDL-C) /HDL-C, whilst TC is generally unaffected. The evidence regarding LDL-C in these studies is equivocal. A possible self-selection bias means that a cause-effect relationship between exercise and the lipoprotein profile cannot be readily established from this design. Correlation studies are difficult to interpret because of differences in participant characteristics, methods employed to assess peak oxygen uptake and habitual physical activity (HPA), and the statistical techniques used to analyse multivariate data. Directly measured cardiorespiratory fitness does not appear to be related to lipoprotein profiles in the children and adolescents studied to date, although there is data to the contrary. The relationship with HPA is more difficult to decipher. The

evidence suggests that a ‘favourable’ lipoprotein profile may be related to higher levels of the HPA, although differences in assessment methods preclude a definitive answer. While few prospective studies exist, the majority of these longitudinal investigations suggests that imposed regular exercise has little, if any, influence on the lipoprotein levels of children and adolescents. However, most prospective studies have several serious methodological design weaknesses, including low sample size, inadequate exercise training volume and a lack of control individuals. Recent studies have suggested that increases in HDL-C and reductions in LDL-C may be possible with regular exercise. The identification of a dose-response relationship between exercise training and the lipoprotein profile during the Pediatric years remains elusive.

**Southern (2000)**\(^{32}\) studied Safe and effective exercise programs are needed to prevent and treat chronic diseases in childhood. In particular, preadolescent obese children should participate in activities that are specific to their special needs. Resistance or strength training has been prescribed for adult obese persons. Research is limited concerning the use of resistance training in programs that treat obese preadolescents. Nineteen treatment subjects (7-12 years of age) were enrolled in a 10-week weight management program which included diet, behavior modification, and aerobic and flexibility exercises. Forty-eight control subjects (7-12 years of age) participated in the diet, behavior

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modification program, and a thrice-a-week walking program. The efficacy of the overall weight management program was examined by anthropometry at 10 weeks and 1 year. Fifteen treatment subjects completed the 10-week program (retention rate, 78.9%). Thereafter compliance decreased by approximately 33% for the long-term study. Seventeen control subjects completed the program (retention rate, 35%). Weight, percent of ideal body weight, and body mass index were reduced significantly at 10 weeks ($P < 0.0001$) and did not increase significantly at 1-year follow-up in both treatment and control groups. Height increased significantly at 1 year in both treatment and control subjects. In the treatment subjects, percent fat decreased significantly ($P < 0.001$), whereas fat-free mass did not change significantly ($P > 0.05$). A resistance-training program may be included safely in a multidisciplinary weight management program for obese preadolescent male and female children. The addition of specific exercise regimes such as resistance training may improve program retention especially in severely obese youth.

Sothern et al. (2000) studied the Childhood obesity has been associated with elevated serum levels of total cholesterol, triglycerides, and low-density lipoproteins (LDLs). The researcher observed the lipid profiles of obese female subjects versus obese male subjects before and after significant weight loss.

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They studied 29 girls and 21 boys enrolled in a multidisciplinary weight reduction program. Measures were taken at enrolment and at 10 weeks. Significant improvements were observed for changes in percentage of ideal body weight and total cholesterol and triglyceride levels. In addition, LDL decreased significantly in girls but not in boys. A combination of diet, behaviour modification, and exercise, is an effective instrument for lowering total cholesterol and triglyceride levels in obese children. In addition, girls tend to be more susceptible to a decrease in LDL level, which might result in an increased cardiovascular protective effect.

Berkey, et al (1999) conducted a study on “Activity, Dietary Intake, and Weight Changes in a Longitudinal Study of Preadolescent and Adolescent Boys and Girls”. To examine the role of physical activity, inactivity, and dietary patterns on annual weight changes among preadolescents and adolescents, taking growth and development into account. They studied a cohort of 6149 girls and 4620 boys from all over the United States who were 9 to 14 years old in 1996. All returned questionnaires in the fall of 1996 and a year later in 1997. Each child provided his or her current height and weight and a detailed assessment of typical past-year dietary intakes, physical activities, and recreational in activities. And hypothesized were that physical activity and dietary fiber intake are

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Berkey, Catherine S.; Helaine R.H. Rockett; Alison E. Field; Matthew W. Gillman; A. Lindsay Frazier ; Carlos A. Camargo ; Graham A. Colditz. “Activity, Dietary Intake, and Weight Changes in a Longitudinal Study of Preadolescent and Adolescent Boys and Girls”, American Academy of Pediatrics (December 3, 1999), Vol. 105(4) : 56.
negatively correlated with annual changes in audacity and that recreational inactivity like TV and video games, caloric intake, and dietary fat intake are positively correlated with annual changes in audacity. Separates for boys and girls, performed regression analysis of 1-year change in body mass index (BMI; kg/m²). They hypothesized factors were in the model simultaneously with several adjustment factors. Larger increases in BMI from 1996 to 1997 were among girls who reported higher caloric intakes (.0061 ± .0026 kg/m² per 100 kcal/day; β ± standard error), less physical activity (−.0284 ± .0142 kg/m²/hour/day) and more time with TV and video games (.0372 ± .0106 kg/m²/hour/day) during the year between the 2 BMI assessments. Larger BMI increases were among boys who reported more time with TV and video games (0.0384 ± 0.0101) during the year. For both boys and girls, a larger rise in caloric intake from 1996 to 1997 predicted larger BMI increases (girls: .0059 ± .0027 kg/m² per increase of 100 kcal/day; boys: .0082 ± .0030). No significant associations were noted for energy-adjusted dietary fat or fiber and conclusion for both boys and girls, a 1-year increase in BMI was larger in those who reported more time with TV and video games during the year between the 2 BMI measurements, and in those who reported that their caloric intakes increased more from 1 year to the next. Larger year-to-year increases in BMI were also seen among girls who reported higher caloric intakes and less physical activity during the year between the 2 BMI measurements. Although the
magnitudes of these estimated effects were small, their cumulative effects, year after year during adolescence, would produce substantial gains in body weight.

Suwan et al. (1998) examined the exercise has been found to be effective for prevention of the weight gain and maintenance of a stable weight in adults. The objective of this study was to evaluate the effect of a school-based aerobic exercise program on the obesity indexes of preschool children. Subjects were 292 second-year elementary school pupils from 2 kindergartens in the Hat Yai municipality, Songkhla province, southern Thailand. A specially designed exercise program, including a 15-min walk before beginning the morning class and a 20-min aerobic dance session after the afternoon nap, 3 times a week, researcher conducted for 29.6 wk. Weight, height, and triceps skinfold thickness were measured 4 times. At the end of the study, the prevalence of obesity, using the 95th percentile National Center for Health Statistics triceps-skinfold-thickness cutoffs, of both the exercise and control groups decreased. That of the exercise group decreased from 12.2% at baseline to 8.8% (Wilcoxon signed-rank test, P = 0.058), whereas that of the control group decreased from 11.7% to 9.7% (Wilcoxon signed-rank test, P = 0.179). A sex difference in the response of body mass index (BMI) to exercise was observed. Girls in the exercise group had a lower likelihood of having an increasing BMI slope than the control girls did (odds ratio: 0.32; 95% CI: 0.18, 0.56). In conclusion, our study suggests that a

29.6-wk school-based exercise program can prevent BMI gain in girls and may induce a remission of obesity in preschool-age children.

James and Frederick (1998)\textsuperscript{36} studied the threat of obesity is greater than ever for US children and adolescents. All indications are that the current generation of children will grow into the most obese generation of adults in US history. Furthermore, there is every expectation that the next generation of children is likely to be fatter and less fit than the current generation. Despite the recognition of the severe health and psychosocial damage done by childhood obesity, it remains low on the public agenda of important issues facing policy makers. Perhaps this is because the most serious health effects of obesity in today's children will not be seen for several decades. Action must be taken now to stem the epidemic of childhood obesity. This action will require a prioritization of research into the etiology, treatment, and prevention of childhood obesity. It is unlikely that sufficient resources for such research will be available from public and private sources until the issue of childhood obesity is moving higher on the public agenda.

Goran et al. (1997)\textsuperscript{37} examined whether the body fat content in pre-pubertal children is influenced by physical activity related energy expenditure (AEE) and/or more qualitative aspects of physical activity. Cross-sectional

\textsuperscript{36} James, Hill O.; and Frederick, Trowbridge L. “Childhood Obesity: Future Directions and Research Priorities.” Pediatrics, (March 1, 1998) Vol.101(3) : 570 -574..

study. And 101 pre-pubertal children were examined in Study 1: (age: 5.3 ± 0.9 y; weight: 20.2 ± 3.6 kg). In Study 2: 68 of the original children were re-examined (age: 6.3 ± 0.9 y; weight: 23.6 ± 5.0 y). And Fat mass (FM) and fat free mass (FFM) were determined by bioelectrical resistance and skinfold All was estimated from the difference between total energy expenditure (TEE) by doubly labeled water and post-prandial resting energy expenditure (REE) by indirect calorimetry qualitative information on activity was derived by questionnaire. And the results were AEE was significantly correlated with FFM (r= 0.32 in both Studies) and body weight (r= 0.28 in Study 1; r = 0.29 in Study 2), but not FM. There were no significant relationships between AEE and any of the variables from the activity questionnaire in children (including TV time, playing time, and an accumulated activity index in h/week). After adjusting for FFM, age, and gender, FM was inversely related to activity time in h/week (partial r = - 0.24 in Study 1; partial r= - 0.32 in Study 2) but not AEE (P > 0.5). And the conclusion was after adjusting for FFM, age, and gender; a small portion of the variance in body fat mass in children (10%) is explained by the time devoted to recreational activity, whereas none of the variance is explained by the combined daily energy expenditure related to physical activity.

**Epstein (1996)**[^38] examined the use of exercise programs with obese children and adolescents. Studies included for review met two criteria: 1)

children or adolescents were defined as obese using objective criteria for obesity, and 2) obese children or adolescents were provided either different types of exercise programs or an exercise program compared with a no-exercise control condition. Thirteen controlled outcome studies were identified. Experimental design, methods, and outcomes are presented and evaluated for each study. Factors that should be considered in research testing exercise interventions are discussed, including adherence, diet, age, gender, and type of exercise. In addition, the potential for exercise programs in the prevention of obesity in childhood and adolescence is discussed. The results support the continued use of exercise in combination with diet for child and adolescent obesity treatment, but the limited number of controlled studies indicates the need for more research in the area. The potential for exercise programs in the prevention of obesity in childhood and adolescence is discussed.

Caprio et al. (1996)\textsuperscript{39} studied the time course of changes in insulin action and secretion that occur early during the development of obesity, researcher studied children before the onset of puberty. The reason for choosing the prepubertal stage of development is that it is metabolically characterized by both a high sensitivity to insulin and low glucose stimulated insulin responses. Fifteen obese preadolescents (8 male/7 female, age 10 ± 0.4 years, body mass index (BMI) 31 ± 1.2 kg/m$^2$ Tanner Stage I) with a duration of obesity of less

than 5 years and 10 non-obese preadolescents (6 male/4 female, age 10 ± 0.4 years, BMI 18 ± 0.9 kg/m²) matched for gender were studied. In a cross-sectional analysis, they compared responses in obese preadolescents, with those in obese adolescents and obese adults with a long duration of obesity. The euglycaemic hyperinsulinaemic clamp with 1-13C-glucose and indirect calorimetry were used to quantitate insulin action and the hyperglycaemic clamp used to assess beta-cell function. Insulin-stimulated glucose uptake measured at two physiological levels of hyperinsulinaemia (180 and 480 pmol) was reduced by 20 and 45% in all three groups of obese compared to non-obese subjects (p < 0.01). Defects in oxidative and non-oxidative glucose metabolism were observed in all three groups of obese subjects at the higher insulin infusion rate. The ability of insulin to inhibit lipid oxidation was impaired in all three obese groups at both levels of hyperinsulinaemia. Increases in basal and glucose-stimulated insulin levels during the hyperglycaemic clamp mirrored the reductions in glucose uptake during the insulin clamp in all obese groups. These results indicate that insulin resistance and hyperinsulinaemia co-exist in preadolescent children with moderate to severe obesity.

Sung (1995) examined the effects of a low energy diet, with or without strength training, on blood lipid profile in obese children. Eighty two obese children were enrolled in a six week dietary programme, and were randomly

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allocated to a training group or a non-training group. The training group underwent regular exercise sessions with emphasis on strength training. Height increased significantly, with a non-significant reduction in body mass index. Fat free mass increased significantly in the training group. Serum total cholesterol was significantly reduced in both groups. The LDL: HDL ratio significantly decreased in the training group. Results support the potentially beneficial effects of both diet and physical training. Further and longer term evaluation of such programmes is required.

**Hager, Tucker and Seljaas (1995)**[^41] examined the association between aerobic fitness and serum cholesterol and the effects of controlling for gender, body composition, abdominal fat, and dietary saturated fat in 262 children. The 1-mile run was used to estimate fitness. Skinfolds were used in assessing body fat. Fit children had lower total cholesterol, low-density lipoprotein cholesterol, and triglyceride levels and higher high-density lipoprotein cholesterol levels than unfit children, except after adjustment for body fat and/or abdominal fat. Unfit children appear to be at an increased risk of unhealthy levels of serum cholesterol due primarily to increased levels of body fat.

Troiano et al. (1995) conducted a study on “Overweight prevalence and trends for children and adolescents” The purpose of the study was to examine prevalence of overweight and trends in overweight for children and adolescents in the US population. Nationally representative cross-sectional surveys with an in-person interview and a medical examination, including measurement of height and weight design was used. Between 3000 and 14,000 youths aged 6 through 17 years examined in each of five separate national surveys during 1963 to 1965, 1966 to 1970, 1971 to 1974, 1976 to 1980, and 1988 to 1991 (Cycles II and III of the National Health Examination Survey, and the first, second, and third National Health and Nutrition Examination Surveys, respectively). Prevalence of overweight based on body mass index and 85th or 95th percentile cutoff points from Cycles II and III of the National Health Examination Survey. The results revealed that from 1988 to 1991, the prevalence of overweight was 10.9% based on the 95th percentile and 22% based on the 85th percentile. Overweight prevalence increased during the period examined among all sex and age groups. The increase was greatest since 1976 to 1980, similar to findings previously reported for adults in the United States. It concludes that Increasing overweight among youths implies a need to focus on primary prevention.

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Gazzaniga and Burns (1993) examined the relationship between diet composition and body fat in 48 children (25 girls, 23 boys) aged 9-11 y). Subjects were identified for the two study groups, non-obese [triceps skinfold (TSF) thickness < 85th percentile] and obese (TSF thickness > or = 85th percentile). Measures for dietary intake, physical activity, resting energy expenditure (REE), and body composition were obtained by three 24-h dietary and activity recalls; indirect calorimetry; and anthropometrics, respectively. Percentage of body fat correlated positively with intakes of total (P < 0.0001), saturated (P < 0.01), monounsaturated (P < 0.0001), and polyunsaturated (P < 0.01) fatty acids, and negatively with carbohydrate intake (P < 0.001) and total energy intake adjusted for body weight (P < 0.001). After adjustment for study group, energy intake, REE, and physical activity, the associations remained in total, saturated, and monounsaturated fatty acid and carbohydrate intakes. These data suggest that diet composition, independent of total energy intake, REE, and physical activity may contribute to childhood obesity.

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2.3 REVIEWS RELATED TO YOGA TRAINING:

Yokesh and Chandrasekaran (2011) investigated the impact of yogic practice and aerobic exercise among overweight school boys. To achieve this purpose, sixty overweight school boys from various schools in Tiruchirappalli district were selected at random. Their age ranged between 14 and 17. The selected subjects were divided into three equal groups of 20 each, namely yogic practice group (group A), aerobic exercise group (group B) and control group (group C). The group A had undergone yogic practice; group B had undergone aerobic exercise for 12 weeks, five days a week, whereas the control group (group C) maintained their daily routine activities and no special training was given. The subjects of the three groups were tested using standardized tests and procedures on selected physical and physiological variables before and after the training period to find out the training efforts in the following test items: physical variables abdominal muscular strength and physiological variables breath holding time. The collected data were analyzed statistically through analysis of Co-Variance (ANACOVA) and Scheffe’s post hoc test to find out the pre and post training performances. Compare the significant difference between the adjusted final means and better group.

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Sultana (2011)\textsuperscript{45} studied the effects of yoga practice on dominate hand grip strength of female students. Forty female subjects were selected from various Departments in Pondicherry University and their age ranged from 18 to 25 years. The subjects were divided into four groups’ namely Right nostril breathing group (Asanas and Suriya Bhedana), Left nostril (Asanas and Chandra Bhedana), Alternate nostril breathing group (Asanas and Nadisudhi) and control group. The experimental group underwent selected asanas and pranayama practice for ten days. Control group did not undergo any training programme rather than their routine work. Hand grip strength was measured through hand grip dynamometer. Prior to and after end of practice period all subjects were tested. The results of pre-test and post-test were compared with using Analysis of Co-variance. The yogic practices three groups significantly improved hand grip strength, Alternate nostril breathing group (Asanas and Nadisudhi) is better improved compared than other groups.

Sugumar (2011)\textsuperscript{46} study was framed find out the effect of yogic practices on body composition among the college men students. Thirty healthy, untrained male subjects were selected from various Departments of Gandhigram Rural Institute, Deemed University, Gandhigram, Dindigual and their age ranged from


18 to 25 years. The subjects were equally divided into two groups namely the control and the experimental group. The experimental group underwent selected asanas and pranayama for five days per week for six weeks. Control group did not undergo any training programme rather than their routine work. Body composition was measured by using BIA method in the three sites. Prior to and after end of practice period all subjects were tested. The results of pre-test and post-test were compared with using Analysis of Co-variance. Finding of body composition shows significant improvement due to the six weeks yogic practice when compared to the control group.

**Sreenimurugan, Selvakumar and Jeyaveerapandian (2011)** studied effect of selected yogic practices on body composition of college students. Sixty male subjects were selected from Madurai District College students, Madurai and their age ranged from 18 to 21 years. The subjects were equally divided into two groups namely the control and the experimental group. The experimental group underwent selected asanas and pranayama weekly five classes for twelve weeks. Control group did not undergo any training programme rather than their routine work. Body composition was measured using by skin fold caliper. Prior to and after end of practice period all subjects were tested. The results of pre-test and post-test were compared with using Analysis of Covariance. The yogic

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practices groups significantly improved body composition when compared to the control group.

Sokkanathan and Selvakumar (2011)\textsuperscript{48} studied effect of selected yogic practice on muscular endurance of school children. Sixty male subjects were selected from Madurai District Matriculation Higher secondary school, Madurai and their age ranged from 14 to 15 years. The subjects were divided into two groups namely the control and the experimental group. The experimental group underwent selected asanas and pranayama practice weekly five classes for twelve weeks. Control group did not undergo any training programme rather than their routine work. Muscular endurance was measured through field tests using by bent knee sit ups. Prior to and after end of practice period all subjects were tested. The results of pre-test and posttest were compared with using Analysis of Co-variance. The yogic practices groups significantly improved muscular endurance when compared to the control group.

Selvakumar, Chandrasekar and Pushparaj (2011)\textsuperscript{49} conducted the effect of selected yogic practices on cardiovascular endurance of college students. Sixty male subjects were selected from Thiagarajar College, Madurai and their age ranged from 18 to 20 years. The subjects were divided into two


groups namely the control and the experimental group. The experimental group underwent selected asanas and pranayama practice weekly five classes for twelve weeks. Control group did not undergo any training programme rather than their routine work. Cardio vascular endurance was measured through field test using by one mile run and walk. Prior to and after end of practice period all subjects were tested. The results of pre-test and post-test were compared with using Analysis of Co-variance. Finding of cardio vascular endurance shows significant improvement due to the practices of yoga when compared to the control group.

Sekarbabu and Kulothugan (2011) studied the effect of yogic practices on selected physiological variables of men hockey players. Thirty hockey men players were selected from Annamalai University, Chidambaram and their age ranged from 18 to 25 years. The subjects were divided into two groups namely the control and the experimental group. The experimental group underwent forty five minutes selected asanas and pranayama practice five classes per week for eight weeks. Control group did not undergo any training programme rather than their routine work. Cardio respiratory endurance was measured by using Cooper,s twelve minutes run and walk test, however the breath hold time was measured by the standard stop watch and resting pulse rate measured by using stethoscope. Prior to and after end of practice period all

subjects were tested. The results of pre-test and post-test were compared with using Analysis of Co-variance. The yogic practices groups significantly improved Cardio respiratory endurance, breath hold time and significantly decreased resting pulse rate when compared to the control group.

**Rajkumar (2011)**\(^{51}\) found out the effect of yogic practices for weight control for obese men students. Thirty two obese men students were selected from Pavendhar Bharathidasan institute of information technology, Tiruchirapalli and their aged from 17 to 21. The subjects were divided into two groups namely the control and the experimental group. The experimental group underwent selected yogic practices for eight weeks. Control group did not undergo any training programme rather than their routine work. All the two groups were tested on selected criterion variables such as body weight measured using by weighing machine, forearm and thigh circumference measured using by steel measuring tap and body composition measure using by skin fold caliper of biceps and triceps. Prior to and after end of practice period all subjects were tested. The results of pre-test and post-test were compared with using Analysis of Co-variance. The yogic practices groups significantly improved body weight, forearm and thigh circumference and body composition when compared to the control group.

Komathi and Kalimuthu (2011)\textsuperscript{52} study was framed find out the effect of yogic practices on abdominal strength among school boys. Forty subjects were selected from A.R.R Matriculation higher secondary school and their age ranged from 15 to 17 years. The subjects were divided into two groups namely the control and the experimental group. The experimental group underwent selected asanas and pranayama for five days per week for twelve weeks. Control group did not undergo any training programme rather than their routine work. The abdominal strength was measured by using sit ups. Prior to and after end of practice period all subjects were tested. The results of pre-test and post-test were compared with using Analysis of Covariance. Finding of abdominal strength shows significant improvement due to the twelve weeks yogic practice when compared to the control group.

Bharatha Priya and Gopinath (2011)\textsuperscript{53} studied the effect of yogic practice on flexibility among school boys. Forty subjects were selected from A.R.R Matriculation higher secondary school and their age ranged from 15 to 17 years. The subjects were divided into two groups namely the control and the experimental group. The experimental group underwent selected asanas and pranayama for five days per week for twelve weeks. Control group did not


undergo any training programme rather than their routine work. Flexibility was measured by using sit and reach box. Prior to and after end of practice period all subjects were tested. The results of pre-test and posttest were compared with using Analysis of Co-variance. Finding of flexibility shows significant improvement due to the twelve weeks yogic practice when compared to the control group.

_Telles (2010)_54 investigated on “Short term health impact of a yoga and diet change program on obesity”. The Obese persons often find physical activity difficult. The effects of a yoga and diet change program, emphasizing breathing techniques practiced while seated, was assessed in obese persons. A single group of 47 persons was assessed on the first and last day of a yoga and diet change program, with 6 days of the intervention between assessments. The assessments were: body mass index (BMI), waist and hip circumferences, mid-arm circumference, body composition, hand grip strength, postural stability, serum lipid profile and fasting serum leptin levels. Participants practiced yoga for 5 hours every day and had a low fat, high fiber, vegetarian diet. Last and first day data were compared using a t-test for paired data. Following the 6-day residential program, participants showed a decrease in BMI (1.6 percent), waist and hip circumferences, fat-free mass, total cholesterol (7.7 percent decrease), high density lipoprotein (HDL) cholesterol (8.7 percent decrease), fasting serum leptin levels.

leptin levels (44.2 percent decrease) and an increase in postural stability and hand grip strength \((p<0.05, \text{ all comparisons})\). A 6-day yoga and diet change program decreased the BMI and the fat-free mass. Total cholesterol also decreased due to reduced HDL levels. The study suggested that a brief, intensive yoga program with a change in diet can pose certain risks. Benefits seen were better postural stability, grip strength (though a ‘practice effect’ was not ruled out), reduced waist and hip circumferences and a decrease in serum leptin levels.

Shenbagavalli1 and Divya (2010)\(^{55}\) investigated on the Effect of Specific Yogic Exercises and Combination of Specific Yogic Exercises with Autogenic Training On Selected Physiological, Psychological and Biochemical Variables of College Men Students. The purpose of the study was to find out the effect of specific yogic exercises programme and combination of specific yogic exercises with autogenic training programme on selected physiological variables such as pulse rate, vital capacity, percent body fat, psychological variables such as job anxiety, occupational stress and biochemical variables such as high density lipoprotein, low density lipoprotein and fasting blood sugar of the college men students. Sixty Men students in the age group of 20 to 30 years from the Alagappa University were randomly selected and served as the subjects for the purpose of this study. The study was formulated as a random group design consisting of specific yogic exercises and combination of specific yogic exercise

with autogenic training groups. The subjects (N=60) were at random divided into three equal groups. Experimental group I - was administered specific yogic exercise group, Experimental group II- underwent combination of specific yogic exercises with autogenic training group and control group. All the groups were subjected to pre-test prior to the experimental treatment. The experimental groups participated in their respective duration of 12 weeks, six days in a week throughout the study. Analysis of Co-variance (ANACOVA) was applied to determine the significance of mean difference between the three groups. Then F-ratio was found to be significant, the Scheffe’s Post Hoc test was applied to test the significance of pairs of the adjusted final group means. Practice of the combination of specific yogic exercises with autogenic training and specific yogic exercises programme is significantly effective in promoting desirable changes in the dependent variables. The study concludes that the practice of the combination of specific yogic exercises with autogenic training programme is significantly effective than the specific yogic exercises programme and control group in promoting desirable changes in selected physiological variables such as pulse rate, vital capacity, percent body fat, psychological variables such as job anxiety, occupational stress and biochemical variables such as high density lipoprotin, low density lipoprotein and fasting blood sugar among the college men students. Practice of the specific yogic exercises programme is significantly effective than the control group in promoting desirable changes in selected physiological variables such as vital capacity, percent body fat, psychological variables such as job anxiety, occupational stress and biochemical variables such
as high density lipoprotein, low density lipoprotein, fasting blood sugar among
the college men students.

Rane and Asai (2010) conducted a study on “Aerobics Training Programme on Body Fat and Selected Anthropometric Measurements of Obese Girls.” In this study a sampling of 50 females subjects were selected from Gyan Kendra Secondary School, Mumbai, by using the BMI formula by considering purposive sampling technique. They were in the age group of 12 to 14 years. The investigator were select two groups viz; experimental and control groups. The experimental group was given training in aerobic and control group were under going day to day activity. The duration of experimental group is for eight weeks. From the interpretation of the data the results of Anthropometric measurements which shows significant enhancement in body weight in which ‘t’ value is -4.02 which is statistically significant at the 0.01 level. B.M.I measurement, ‘t’ value is 2.94 which is significant at 0.05 level. Chest circumference ‘t’ value is -4.38 is statistically significant at 0.01 level. Abdominal circumference ‘t’ value is -4.16 which is significant at 0.01 level. Thigh circumference ‘t’ value is -8.70 which is significant at 0.01 level. Triceps skinfold, ‘t’ value is -3.26 which is significant at 0.05 level. Sub scapula skinfold, ‘t’ value is -4.98 which is significant at 0.01 level. Therefore statistically concluded that the Aerobic exercise training programme has good effect on B.M.I anthropometric measurement and body fat.

The study revealed that Eight week training of Aerobic exercise imparted in this

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study was effective in reducing excessive body weight and effective in reducing Chest circumference, Abdominal circumference, Thigh circumference. Effective in reducing Triceps, sub scapula, and Thigh skin fold.

Chen et al (2009),\textsuperscript{57} studied the effects of yoga exercise intervention on health related physical fitness in school-age asthmatic children. 31 voluntary children (exercise group 16; control group15) aged 7 to 12 years were purposively sampled from one public elementary school in Taipei County. The yoga exercise program was practiced by the exercise group three times per week for a consecutive 7 week period. Each 60- minute yoga session included 10 minutes of warm-up and breathing exercises, 40 minutes of yoga postures, and 10 minutes of cool down exercises. Fitness scores were assessed at pre-exercise (baseline) and at the seventh and ninth week after intervention completion. A total of 31 subjects (exercise group 16; control group 15) completed follow-up. There was improved BMI, flexibility, muscular strength, and cardiopulmonary fitness after yoga practice among yoga group, where as no changes were noticed among control group subjects.

Madanmohan et al (2008),\textsuperscript{58} studied the effect of six weeks yoga training on weight loss following step test, respiratory pressures, hand grip strength and handgrip endurance in young healthy subjects. Out of 46 healthy


subjects (30 males and 16 females, aged 17–20 yr), 23 motivated subjects (15 male and 8 female) were given yoga training and the remaining 23 subjects served as controls. Weight loss following Harvard step test (an index of sweat loss), maximum inspiratory pressure, maximum expiratory pressure, 40 mm endurance, handgrip strength and handgrip endurance were determined before and after the six week study period. In the yoga group, weight loss in response to Harvard step test was 64±30 g after yoga training as compared to 161±133 g before the training and the difference was significant (n = 15 male subjects < 0.01). In contrast, weight loss following step test was not significantly different in the control group at the end of the study period. Yoga training produced a marked increase in respiratory pressures and endurance in 40mm Hg test in both male and female subjects (P < 0.05 for all comparisons). In conclusion, the present study demonstrates attenuation of the sweating response to step test by yoga training. Further, yoga training for a short period of six weeks can produce significant improvements in respiratory muscle strength and endurance.

Venkatareddy (2003) studied the effect of yoga on weight and fat fold thickness among obese women. 30 obese woman of age 19–53, categorized into two groups, as per body mass index (BMI), were exposed to one-hour practice of asanas and pranayama in the morning for the period of 90 days. A significant reduction in BMI was seen in both groups. In group I (BMI greater than 35) the reduction was greater as compared to group II (BMI 25-35). Lean body mass (LBM), however, did not show significant change in both the groups.

Tran (2001)\textsuperscript{60} studied the effects of hatha yoga practice on the health-related aspects of physical fitness. Ten healthy, untrained volunteers (nine females and one male), selected ranging in age from 18-27 years. The health-related physical fitness variables are muscular strength and endurance, flexibility, cardio respiratory fitness and body composition selected. Subjects were required to attend a minimum of two yoga classes per week for a total of 8 weeks. Each yoga session consisted of 10 minutes of pranayamas (breath-control exercises), 15 minutes of dynamic warm-up exercises, 50 minutes of asanas (yoga postures), and 10 minutes of supine relaxation in savasana (corpse pose). The subjects were evaluated before and after the 8-week training program. Isokinetic muscular strength for elbow extension, elbow flexion, and knee extension increased by 31\%, 19\%, and 28\% respectively, whereas isometric muscular endurance for knee flexion increased 57\%. Ankle flexibility, shoulder elevation, trunk extension, and trunk flexion were also increased relatively there was increase in maximal oxygen uptake.

John (2000)\textsuperscript{61} evaluated the response of selected asanas on balance, flexibility, muscular endurance and reaction time among school boys. Thirty healthy, untrained school boys were selected from Kalapet in Pondicherry and their age ranged from 10 to 15 years. The subjects were equally divided into two groups namely control and experimental group. The experimental group


underwent selected asanas practice for one hour duration for ten weeks. Balance was measured using by stoke stand, flexibility was measured with the reliable equipment sit and reach box. Muscular endurance was measured using by bent knee sit ups and reaction time was measured using by nelson hand stick. The results of pre-test and post-test were compared by using Analysis of Covariance (ANCOVA). The results revealed that Balance, flexibility, muscular endurance variables were significantly improved after practice of asanas.

**Raghuraj (1996)** conducted study to determine whether breathing through a particular nostril has a lateralized effect on hand grip strength. 130 right hands dominant, school children between 11 and 18 yrs of age were randomly assigned to 5 groups. Each group had a specific yoga practice in addition to the regular program for a 10 days yoga camp. The practices were: (1) right, (2) left, (3) alternate- nostril breathing (4) breath awareness and (5) practice of mudras. Hand grip strength of both hands was assessed initially and at the end of 10 days for all 5 groups. The right, left and alternate- nostril breathing groups had a significant increase in grip strength of both hands, ranging from 4.1% to 6.5%, at the end of the camp though without any lateralization effect. The breath awareness and mudra groups showed no change. Hence the present results suggest that yoga breathing through a particular nostril, or through alternate nostrils increases hand grip strength of both hands without lateralization.

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Madanmohan (1992), assessed the effect of yoga training on reaction time, respiratory endurance and muscular strength. Twenty seven male medical students were randomly selected from Jawaharlal institute of postgraduate medical education and research in Pondicherry and their aged from 18 to 21 years. They were given yoga training on 12 weeks of 30 minute for six days. Muscular strength was measured using by hand grip dynamometer. The results of pre- test and post- test were compared by using t ratio test. There was significant improvement on reaction time, respiratory endurance and muscular strength among male students after the intervention.

2.4 SUMMARY OF THE LITERATURE

The review of literature helped the investigator to spot out relevant topics and variables. Further the literature helped the investigator to frame the suitable hypothesis leading to the problems. The latest literature also helped the investigator to support his finding with regard to the problem. Further the literature collected in the study also helped the research scholar to summarize his study.

The reviews were presented under the two sections such as obesity (45) and yoga training (17). All the research studies proved that the yogic training programme contribute significantly for better development of dependent

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variables. The research studies reviewed were collected from journals available in the websites and some university libraries.

The purpose of this study was to examine the effect of Yogasanas on Body Composition and selected Anthropometric Measurements. Some researchers have been conducted studies on various aspects of yogasanas, physical exercises, pranayama and meditation exploring the effects on reducing overweight and body fat % of children, sports persons, college students, adults, but it is much needed to research, especially on the effect of Yogasanas on Body composition and anthropometric measurements of secondary school obese children still exists. Past studies have shown a positive effect of Yogasanas on body composition and anthropometric measurements.

It is also observed from the reviews of literature that no research studies have been conducted in relation to yogic training on body composition and anthropometric measurements variables of secondary school obese boys. This motivated the researcher to select this study.