Summary and Conclusion

Obesity compounds a common adolescent problem of low self-esteem and can disrupt psychosocial development, interfering with the normal process of adolescence, a timeless journey that prepares the child for adulthood. An obese young person may have difficulty dealing with peers and this communication problem can seriously disrupt normal adolescent development. Psychological complications have been associated with obesity in adolescents, including depression, poor self-image, and difficulties in both home and social environment (including school). Potential medical complications of obesity noted in adolescence and especially in adulthood, include hypertension, coronary artery disease, diabetes mellitus, dyslipidemia, cholecystitis, premature joint destruction, arthritis, stroke, some cancers, premature death and many others (Bhargava et al., 2004).

World Health Organization estimates that approximately 1.6 million adult (age 15+) were overweight and at least 400 million adult were obese globally in 2005. By 2015, approximately 2.3 billion adults will be overweight and more than 700 million will be obese (WHO, 2000). Obesity has become a public health concern with an over increasing prevalence in adolescence and childhood populations (James and Keer, 2005). The developing world now confirms the dual challenge of competing chronic under nutrition characterized by short stature and over nutrition reflected by a high weight for height, in the same person. Childhood obesity may result from a number of underlying causes including less healthy eating patterns, engaging in less physical activity, more sedentary behavior, and cultural attitudes about body weight (Raton et al., 2005). Dietz (2004) stated that obesity is a monumental dilemma affecting the health and well-being of the world’s population. This is not a new problem, but rather a rapidly increasing one among children, adolescents and adults. The reasons for this escalation are multifactorial; each must be appreciated and precisely addressed before solutions to
obesity are practical. In every region of the world, obesity doubled between 1980 and 2008,” says Dr Ties Boerma, Director of the Department of Health Statistics and Information Systems at WHO. “Today, half a billion people (12 per cent of the world’s population) are considered obese.” The highest obesity levels are in the WHO Region of the Americas (26 per cent of adults) and the lowest in the WHO South-East Asia Region (3 per cent obese). In all parts of the world, women are more likely to be obese than men, and thus at greater risk of diabetes, cardiovascular disease and some cancers (www.who.int).

In Tamilnadu, main emphasis has been placed on under nutrition but over nutrition, the other side of the coin has not been investigated specifically at the beginning age of adolescence from 12 years of age. This stage of life is of great importance and development of obesity at this period may have adverse effect on their health and personal achievements. Psychological and dietary factors can be either the cause or the effect of obesity. Considering all these points, the present research work was undertaken to assess the health status of adolescents belonging to the age group of 12 to 17 years in the selected Districts namely Coimbatore, Madurai, Salem, Tiruchirappalli, and Tirunelveli from Tamil Nadu.

Body Mass Index (BMI) is defined as the ratio of body weight to body height squared, expressed as kg/m². BMI was classified using CDC percentiles (Centers for Disease Control and Prevention, 2000). Adolescents with BMI more than or equal to 95th percentile with respect to age and gender were considered as obese, between 85th percentile and less than 95th percentile were considered as overweight and between 5th percentile and less than 85th percentile were considered as healthy weight and less than 5th percentile were considered as under nourished.

The present study entitled “Food consumption and Lifestyle Pattern of Obese Adolescents and the Impact of Nutrition Intervention in Selected Districts of Tamilnadu” was undertaken with the major objectives of determining the prevalence of obesity among adolescents in the selected Districts of
Tamilnadu, assessing the health status of boys and girls among the selected adolescents in the age group of 12 to 17 years, the contributing factors of obesity among adolescents, analysing the food consumption and lifestyle pattern of the selected obese adolescents, interrelating the etiological factors, food consumption and lifestyle pattern of obese adolescents with underweight, normal and overweight adolescents, promoting healthy eating habits and positive lifestyle practices to the selected adolescents through nutrition intervention programme, and evaluating the impact of nutrition intervention programme among obese adolescents in the selected Districts.

Tamilnadu is one of the 28 states of India. The state of Tamilnadu, situated in the southeastern India is divided into 32 districts. In Phase I, based on convenience sampling technique, the investigator selected five districts (15 per cent of total districts) of Tamilnadu (Coimbatore, Madurai, Salem, Tiruchirappalli, and Tirunelveli). The demographic data of the selected Districts were collected by the investigator to assess the health status, food consumption and lifestyle pattern of the adolescents and to assess the impact of nutrition intervention.

The schools were selected with the official permission from the inspectors of matriculation schools. The reason for the investigator to select the private schools was because in these schools, the chances of having adolescents who are obese were more. The reason being more adolescents from upper middle class and high income categories were found in large number. Hence based on purposive sampling technique, the investigator conducted the study in 50 private schools.

Adolescents belonging to the age group of 12 to 17 years were included in the study. A stratified random sampling technique was adopted to select the samples to get an equal distribution of adolescents from each age group. The total sampling unit comprises of 6000 adolescents. One thousand and two hundred samples were selected from each district (600 boys and 600 girls). One hundred boys and one hundred girls were selected from each age group.
In Phase II, school authorities were requested by the investigator to provide a list of children attending classes from 7th to 12th standards. Consent letters were obtained from the school authorities and parents to take the anthropometric measurements (height, weight, Body Mass Index) and also to collect data. The anthropometric measurements were recorded by the investigator. Body mass index (BMI) is defined as the ratio of body weight to body height squared, expressed as kg/m². It is important to consider nutritional status during adolescence. The body mass index is one of the most commonly used weights for height measures. BMI was classified using CDC percentiles (Centers for Disease Control and Prevention, 2000).

Food Frequency Questionnaire was developed by the investigator to assess the food consumption pattern. To assess the dietary intake and adequacy of the diet consumed, weighed-food record was adopted for three consecutive days. This method involves recording the weights of all foods prior to their consumption. One hundred and eighty obese adolescents belonged to intervention group were selected for the dietary survey. The weighing was performed by the investigator by using a calibrated scale of the appropriate capacity (2 to 5 kg) and accuracy (± 1 to 5 g). The weight of all foods and beverages consumed by the samples and of any edible or non-edible leftovers were recorded by the investigator in a booklet. For meals consumed away from home, estimates of the weights were recorded by the subsamples and later checked by the investigator with the help of household measures. From this, the intake of energy, other macronutrients, and micronutrients for individuals was calculated using the Nutritive value of Indian foods Revised Recommended Dietary Allowances (Indian Council of Medical Research, 2010).

In phase III, a well formulated questionnaire was used to assess the socioeconomic status, participation in sports, physical exercise, sleeping habit during day time and holidays, diet (vegetarian or non-vegetarian), junk food consumption, meal pattern, frequency of visiting restaurants and other factors that influence physical health of representative samples of adolescents. The food consumption pattern and lifestyle pattern of the selected adolescents was
compared among the Districts. To be more specific, the investigator also compared the above criteria among the different adolescents (underweight, normal, overweight and obese).

In Phase IV, to create awareness, a health education programme was conducted which focused on the major components such as dissemination of health-related information through lectures and focused group discussions, quizzes, change in canteen menus for healthy eating, health camps for parents and teachers, training of student volunteers for sustainability of the health related programme in school and distribution of pamphlets.

Out of 6000 samples, 1842 samples were found to be obese. In Phase V, twenty per cent of the obese adolescents were selected as subsamples and were randomly assigned as intervention (N=180) and control (N=180) group. Combined strategies of nutrition education, dietary modifications and physical activities such as yoga and exercise were recommended to intervention group subsamples. Nutrition education was imparted to the samples and parents in the Parents Teachers Association meeting. This session involved power point presentation on obesity, causes, risk factors, signs and symptoms, complications, dietary management, treatment and prevention. Compact Discs containing information on obesity were distributed to the samples.

A variety of reduced-calorie menus were planned for the obese adolescents inorder to make it easier for to eat right and lose weight. The sample menus included fresh fruits and vegetables along with other healthy food stuffs.

Yoga reduces stress and promotes healthy mind. The yoga training was conducted on Friday and Saturday in the first and last week of the month. About 60 students attend each session. They were taught pranayama (breath control), kayakalpa (to improve life force and maintain youthfulness) and other physical exercises such as squats and pushups. The adolescents have been asked to practise yoga and exercises at home too.

The control group was separated from the intervention group. The control group did not receive any health intervention tips and they were requested to
maintain their regular curriculum. The subsamples from intervention group were assessed for their daily habits through formulated questionnaire (Daily Wellness Questionnaire).

The salient findings of the study are summarized below.

- A total number of 6000 adolescents belonging to the age group of 12 to 17 years from 50 private schools in five districts of Tamilnadu (Coimbatore, Madurai, Salem, Thiruchirappalli, and Tirunelveli) were screened for their height, weight and BMI. Out of 6000 adolescents, 3000 (50 per cent) were boys and 3000 (50 per cent) were girls.

- The weight of the adolescents increases as the age increases. For example: In Coimbatore District, the mean weight of the boys in the age group of 12 years was 49.9±10.6, whereas the mean weight of the girls belonged to the same age group was 56.9±16.3. The mean weight of the boys and girls in the selected age groups (12 to 17 years) was higher in Coimbatore District when compared to other districts.

- The BMI of the adolescents is constantly increasing as the age increases. In this study, Girls had a higher BMI while compared with boys of the same age.

- Among the selected adolescents, boys and girls with normal BMI were 16 per cent and 19 per cent respectively. The prevalence of overweight was 21 per cent among boys and 23 per cent among girls. The prevalence of obesity was 29 per cent in boys and 32 per cent in girls. The prevalence of underweight was 34 per cent in boys and 26 per cent in girls. Girls had a higher prevalence rate of overweight and obesity while compared with boys.

- Coimbatore District showed a higher prevalence of obesity (23 per cent) while compared to other Districts [Madurai (17 per cent), Salem (22 per cent), Tiruchirappalli (20 per cent), and Tirunelveli (18 per cent)]. The value of chi-square value was significant at five per cent level.
• Self perception of the samples regarding their present body weight was assessed. The actual prevalence of obesity was 29 per cent in boys and 32 per cent in girls. But only 22 per cent of obese boys and 25 per cent of obese girls could rightly perceive that they were above the ideal weight. However, rest of the obese adolescents had the wrong concept that they themselves were of normal body weight. There was a tendency of teenagers to underestimate their weight status.

• Eighty one per cent of adolescents belonging to the higher socioeconomic status were found to be obese, while sixty eight per cent of the middle socioeconomic status was overweight. The prevalence of obesity was found to be very low (5 per cent) in adolescents from the lower socioeconomic group. This findings show that socioeconomic status was related to obesity.

• Eighty eight per cent of adolescents in Coimbatore District, 74 per cent in Salem District, 68 per cent in Tiruchirappalli District, 53 per cent in Tirunelveli District and 45 per cent in Madurai District spent money for buying eatables noted that 20 per cent of boys and five per cent of girls spent money for eatables. Very small per cent of adolescents spent their pocket money for social service and savings.

• Ninety eight per cent of obese adolescents, 78 per cent of overweight adolescents 41 per cent of normal teenagers and 37 per cent of underweight adolescents spent most of their pocket money for consuming eatables. Only six per cent of overweight adolescents and two per cent of obese adolescents saved their pocket money.

• Among boys, non-vegetarianism dominated by 99 per cent of underweight, 97 per cent of normal weight, and 100 per cent of overweight and obese boys whereas among selected girls, non-vegetarianism dominated 99 per cent of underweight, 98 per cent of normal weight, and 100 per cent of overweight and obese girls.
- Thirty nine per cent of overweight boys and 17 per cent of obese boys followed four meal patterns, whereas 49 per cent of overweight girls and 20 per cent of obese girls followed four meal patterns per day.

- Four per cent of underweight boys, seven per cent of underweight girls and six per cent of girls with normal weight had the habit of skipping meals and breakfast, whereas none of the obese girls skipped meals and breakfast.

- Eighty six per cent of obese boys and 66 per cent of overweight boys visited restaurants daily, whereas 81 per cent of overweight and 86 per cent of obese boys consumed junk foods everyday. Among girls, eighty five per cent of obese girls and 80 per cent of overweight girls visited restaurants daily whereas 84 per cent of obese and 95 per cent of overweight girls consumed junk foods everyday.

- Ninety two per cent of obese boys and ninety six per cent of obese girls had the habit of napping during day time and holidays.

- Twelve per cent of obese boys and thirteen per cent of obese girls tried medications for weight reduction, whereas only 15 per cent of obese boys and 21 per cent of obese girls participated in weight management programmes.

- Fifty per cent of obese boys and thirty five per cent of obese girls had evidence of family history of obesity, whereas the rest did not have any family history of obesity. While comparing the prevalence of diseases and health problems it was found that in 67 per cent of the families of obese adolescents, there was a medical history of diabetes mellitus and 96 per cent had history of Cardiovascular disorders.

- A total of 1301 (22 per cent) out of 6000 samples reported to have a positive family history of obesity among first, second and third degree relatives; whereas the selected adolescents were not sure whether any of their fourth degree relatives had ever been diagnosed for obesity.
- Out of 1842 obese adolescents, 783 (43 per cent) reported a family history of obesity. Adolescents who reported a family history of obesity had significantly higher mean BMI than those who reported no such history.

- The birth weight of 93 per cent of obese adolescents and 79 per cent of overweight adolescents was greater than 3.5 kg, whereas only four per cent of normal weight and two per cent of underweight adolescents born with birth weight of more than 3.5 kg. Very few obese and overweight adolescents born with the birth weight of less than 3 kg.

- Sixty three per cent of the obese adolescents were breast fed for a short duration of less than two months. It was also noted that only two per cent of obese adolescents were breast fed for more than a year whereas; 81 per cent of normal adolescents were breast fed for more than a year.

- Among obese adolescents, solid foods were initiated for 90 per cent of obese adolescents at the period of less than four months. But it was noted that solid foods were weaned by their mothers to only three per cent of obese adolescents after six months.

- Seventy eight per cent of adolescents in Tirunelveli District and 76 per cent of adolescents in Madurai District consumed fruits everyday. Forty seven per cent adolescents in Coimbatore District consumed eggs everyday. None of the adolescents in the selected Districts consumed fish daily whereas some of the adolescents preferred other non-vegetarian food items like chicken, mutton and beef everyday.

- Foods containing relatively energy dense were frequently consumed by all the adolescents, but it was comparatively higher in case of obese and overweight samples. Frequency of consumption of the fleshy foods like chicken and beef and eggs were found to be highest among obese adolescents. The frequency of consumption of items like cheese and butter was less but slightly higher by those having more than desirable body
weight while comparing with the underweight and normal adolescents. Daily consumption of milk on a daily basis was almost the same in all adolescents.

- On an average majority of the adolescents (97 per cent) consumed biscuits and chocolates everyday. Everyone was fond of ice creams and only three per cent of adolescents in Madurai District, one per cent in Tiruchirappalli District and two per cent in Tirunelveli District did not prefer ice creams due to due to their health disorders and they were prone to common cold and other throat infection. Rate of consumption of pizza, burger and chat items were found to be higher in Coimbatore District when compared to other districts. Thirty five per cent of adolescents in Madurai District and 33 per cent of adolescents in Tirunelveli District consumed sprouts daily whereas; only two per cent and four per cent of adolescents were consuming sprouts everyday in Coimbatore and Salem Districts respectively.

- Consumption of biscuits, pastries, chocolates, fast foods, fried items, soft drinks, and ice creams was found to be higher among obese adolescents. None was observed without consuming biscuits, chocolates and sweets. Forty seven per cent of adolescents with normal weight consumed sprouts daily, but it is noted that only nine per cent of overweight and three per cent of obese adolescents preferred sprouts as they did not have the habit of consuming it. The reason given was that they did not like the raw taste of the sprouts. Consumption of fried items, pizza and burger were found to be high among obese and overweight adolescents.

- It was observed that gingelly oil was consumed by majority of the adolescents (on an average 58 per cent) followed by groundnut oil and sunflower oil. Eighty eight per cent of obese adolescents and sixty eight per cent of overweight adolescents consumed more than 25 ml of oil per day. It was noted that none of the overweight and obese adolescents consumed less than 10 ml of oil per day.
• Fifty two per cent of obese adolescents’ families adopted baking everyday, whereas 17 per cent of obese adolescent’s families adopted toasting in their cooking methods everyday. Eighty nine per cent of the families of adolescents with normal weight adopted steaming daily whereas only eight per cent of obese adolescents’ families preferred steamed foods everyday. Only few preferred pressure cooking once in a week, because they like to have food cooked in open vessels. Ten per cent of families of underweight adolescents preferred frying daily whereas 84 per cent of the obese adolescents’ families adopted frying everyday, as frying is a method which increases the palatability of the product, comparing to other methods of cooking.

• The nutrient intake of the adolescents except for iron exceeded the Revised Recommended Dietary Allowances (Indian Council of Medical Research, 2010). Among obese adolescents of 17 years, the mean calorie intake was higher among obese boys of Tirunelveli District (3192±14.2) and obese girls of Tiruchirappalli District (2583±92.8) when compared to other districts. This may be due to frequent consumption of energy dense foods and fat-rich foods by the obese adolescents. Calcium intake was higher in Tirunelveli District (Boys - 972.5±19.13; Girls - 961.4±15.52) when compared to other districts. This may be due to the excess consumption of milk and milk products and other calcium rich foods by the adolescents in Tirunelveli District.

• It was clear from the study that television viewing was given priority. Seventy two per cent and 66 per cent of adolescents in Coimbatore and Salem Districts were interested in playing videogames. Seventy three per cent of adolescents in Madurai District and 58 per cent of adolescents in Tirunelveli District had the regular habit of walking. But the percentage was found to be low in Coimbatore District. Five per cent of adolescents practiced yoga in Coimbatore District and this rate was higher when compared to other districts. It was clearly noted, among the adolescents that the duration of playing games, sports, practicing yoga was very low.
Sixty five per cent of overweight and fifty five per cent of obese adolescents were interested in video games. Eighty three per cent of underweight adolescents and ninety one per cent of normal weight adolescents had the regular habit of walking whereas 76 per cent of overweight adolescents and 86 per cent of obese adolescents don’t have the habit of walking. Similarly, among obese adolescents the percentage rate was found to be low in other activities such as sports, games, physical exercise and yoga. The duration of playing games and sports, practicing yoga was lower among obese adolescents when compared with normal weight adolescents.

It was observed that 49 per cent of the adolescents in Coimbatore District used private transport to come to school, whereas adolescents selected from Madurai (62 per cent) Salem (51 per cent), Tiruchirappalli (58 per cent) and Tirunelveli (60 per cent) Districts came to their school by walking. Some of the adolescents used cycles to come to the schools. Based on the circumstances, the mode of transport varies.

There was a significant mean increase in nutrition test score after the nutrition intervention in case of all adolescents. The mean increase in scores was found to be the highest among the intervention group and the least among the control group. This could be due to the fact that intervention group were better access to nutritional information through the investigator and are already better informed (aware) on the causes and health consequences of obesity than the adolescents in the control group. Statistical analysis showed significant result between pre and post scores of intervention group.

It was encouraging to note that the consumption of junk foods by the adolescents was reduced after intervention. It should be noted that only none of the adolescents consumed sprouts before intervention but after intervention it was observed that 81 per cent of adolescents consumed sprouts. The percentage of consumption of chocolates, sweets, chat items,
fried items, burger, pizza, carbonated beverages, and ice creams was found to be low after intervention.

- Among 36 adolescents of the intervention group from each District, 35 adolescents in Madurai District, 30 adolescents in Coimbatore District, 27 adolescents in Tirunelveli District, 26 adolescents in Salem District and 25 adolescents consumed more than 25 ml of oil per day before intervention. But after intervention, their numbers were reduced to three in Coimbatore District, two in Salem and Tiruchirappalli Districts. But, it was encouraging to note that none of them consumed more than 25 ml of oil in Tirunelveli and Madurai Districts.

- The calorie, protein, fat and calcium intake of the adolescents had come down after the nutrition intervention. The mean iron value of the adolescents met their Recommended Dietary Allowances (ICMR, 2010) both qualitatively and quantitatively.

- Before intervention, very few obese adolescents participated in sports, practiced walking and did physical exercise. None other than four adolescent girls in Tirunelveli District practiced yoga. After intervention, the number of adolescents performing walking, sports, physical exercise and practicing yoga were found to be increased. There was no positive impact on television viewing as everyone was fond of watching television programmes. But in case of playing videogames, it was found that there was a reduction in number. It was also observed that after intervention, both boys and girls have gone for a healthy approach regarding their mode of transport. It was highly encouraging to note that two boys and five girls purchased cycles to come school. Earlier they were coming by public transport.

- It was noted that the mean BMI of the subsamples of the intervention group was lower than the calculated mean BMI of the subsamples of the control group.
• It was noted all the subsamples of intervention group selected from five districts were aware about adolescent obesity. This shows that everybody was keen to know the importance of keeping their body healthy.

• Ninety eight per cent of obese adolescents in Coimbatore District, 99 per cent in Salem District, and 99 per cent in Tiruchirappalli District were showed keen interest towards nutrition intervention, whereas hundred per cent of obese adolescents in Tirunelveli and Madurai Districts were interested in attending even more nutrition intervention.

The results of the impact of nutrition intervention between intervention group and control group were analyzed statistically and interpreted. The results of the study showed that well planned nutritional alterations and moderate physical activity in the school curricula will contribute to the prevention of obesity which inturn will make healthy adolescents and future leaders.

**Conclusion**

The thesis on the topic entitled “Food consumption and Lifestyle Pattern of Obese Adolescents and the Impact of Nutrition Intervention in Selected Districts of Tamilnadu” gives a bird’s eye view on the prevalence of obesity, nutritional status and lifestyle habits of children in the selected schools of Tamilnadu. The study showed that adolescent obesity varies from each district with respect to family income, family history, dietary pattern, and lifestyle habits. The nutrient intake of the adolescents except for iron exceeded the Recommended Dietary Allowances. It was also noted that the food intake of girls is higher than boys. Combined strategies of nutrition education, dietary modifications and physical activities such as yoga and exercise were recommended to subsamples of intervention group. The impact of nutrition intervention showed that the adolescents were more aware of the positive aspects of health and nutrition. It was concluded that individually targeted obesity prevention intervention will produce beneficial effects on dietary pattern of the obese adolescents.
Recommendations of the study

- The study should be undertaken at a larger perspective. The prevalence rate of obesity among adolescents in all districts of Tamilnadu should be assessed.

- The genetic composition of obese population should be studied. Studies on interaction of nutrigenomic factors should be carried out widely.

- Food industries should aim at developing and promoting affordable and healthy ready-to-eat food products.

- Obese population should be educated on the consumption of healthy snacks. Fiber rich snacks should be formulated and supplemented to obese adolescents and its impact should be assessed.

- Risk factors for the different grades of obesity should be assessed.

- The health, educational and agricultural sectors should be coordinated to ensure effective government action for the prevention and management of overweight.

- Creating awareness on body weight maintenance through mass media like radio and television channels and conduct of awareness camps at schools, colleges, work places and PHC’s routinely.

- Education modules in the form of software should be developed in future.

- Adolescents should be encouraged to have a balanced diet through nutrition education and should be engaged in activities which would expend their energy.

- Clear cut prophylaxis impact of nutrition intervention programmes should be brought out through longitudinal studies. Body composition studies on different age groups for database generation and to identify the ‘at risk’ population groups susceptible to obesity and hence plan intervention strategies.

- Morbidity and mortality rate of adolescents those who suffer from obesity prone diseases such as diabetes and heart diseases in future should be minimized through school based intervention researches thereby social and economic burden of non-communicable diseases could be minimized.