CONTRIBUTING FACTORS AND PROBLEMS ASSOCIATED WITH OVERWEIGHT AMONG RURAL AND URBAN SCHOOL CHILDREN

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DECLARATION

I hereby declare that this thesis entitled **"Contributing factors and problems associated with overweight among rural and urban school children"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title, of any other university or society.

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CERTIFICATE

Certified that this thesis entitled **"Contributing factors and problems associated with overweight among rural and urban school children"** is a record of research work done independently by Ms. Ambily G. Unnithan (2003-24-02) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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LIST OF ABBREVIATIONS

No	Abbreviation	Full Form
1	AHA	American Heart Association
2	ANOVA	Analysis of Variance
3	BIA	Bio-electrical Impedance Analysis
4	BOD-POD	Air displacement plethy-smography
5	BMI	Body Mass Index
6	CDC	Centre for Disease Control
7	CHD	Coronary Heart Disease
8	CHO	Carbohydrates
9	CT	Computerized Tomography
10	CVD	Coronary Vascular Disease
11	DEXA	Dual Energy X-ray Absorptiometry
12	GERD	Gastro Esophageal Reflux Disease
13	ICMR	Indian Council of Medical Research
14	IOTF	International Obesity Task Force
15	LDL	Low Density Lipoproteins
16	LPL	Lipo Protein Lipase
17	LSES	Low Socio Economic Status
18	MRI	Magnetic Resonance Imaging
19	MUAC	Mid Upper Arm Circumference
20	NCHS	National Centre for Health Statistics
21	NFI	Nutrition Foundation of India
22	NHANES	National Health And Nutrition Education Survey
23	OR-A	Obesity Related - Attitude
24	OR-K	Obesity Related - Knowledge
25	OR-P	Obesity Related - Practices
26	OR-KAP	Obesity Related – Knowledge, Attitude, Practices
27	OSA	Obstructive Sleep Apnea
28	PBSA	Psychosocial and Behavioural Adjustment Scale
29	RDA	Recommended Dietary Allowances
30	RR	Relative Risk
31	TC	Total Cholesterol
32	USES	Upper Socio Economic Status
33	WC	Waist Circumference
34	WHR	Waist Hip Ratio

1. INTRODUCTION

Malnutrition is a "man made disease 'which often' starts in the womb and ends in the tomb". Humankind has faced major shifts in dietary and physical activity patterns and body composition since Paleolithic man emerged on Earth. Over the past three centuries human diet and nutritional status have particularly undergone a sequence of major shifts from healthy eating to nutritionally inadequate calorie rich food habits. These changes in diet coupled with inactive lifestyles have sparked off overweight, obesity and various other health problems associated with it in almost all the countries of the world (Ofei, 2005).

Obesity has become a challenging multifactorial problem with a 5-10 per cent increase in obesity per decade in the last quarter of the century. Thus it is escalating at an alarming rate across the globe in all age groups, especially among the urban people. Obesity today has become a chronic disease of the developed and developing world affecting both children and adults alike (Elizabeth, 2007).

However, the clinical and public health importance of overweight and obesity is still underestimated in many countries around the world. The general acceptance of obesity by many societies as a sign of well-being or a symbol of high social status has contributed to its rise in epidemic proportions. Also the denial by health care professionals and the public alike that obesity is a disease in its own right, have contributed to improper identification and management of the condition and in creating effective public health strategies to combat the situation (Mudur, 2003).

Obesity is a common and preventable condition which contributes to the development of several non-communicable diseases, significant disability and premature death. There is presently a global epidemic of obesity in children as well as adults in both developed and developing countries. The increasing prevalence of obesity also places a large burden on health care expenses throughout the world (Popkin, 2003).

Obese children have substantial risks for morbidity such as hypertension and dyslipidemia even before they reach adulthood (Tounian et al., 2001). Type 2 diabetes is beginning to emerge in children (Fagor-Campagna, 2000). Importantly, 50

to 80 per cent of obese children become obese adults and all complications of adult obesity are made worse if the obesity begins in childhood (Styne, 2001).

Obesity is defined as an excess of body fat frequently resulting in significant impairment of health. When a person gains weight, the body fat cells increase in size and later in number (Williams, 1993). According to Swaminathan (2005) a person whose body weight is higher than normal by 15-20 per cent is considered as overweight and by 25 per cent is considered as obese. Different grades of obesity based on body weight are mild, moderate, severe and very severe where body weight is above normal by 25, 50, 75 and 100 per cent respectively. Obesity is thus a complex condition with serious social and psychological dimensions, that affects virtually all age and socio-economic groups and threatens to overwhelm both developed and developing countries.

Obesity during childhood is a matter of growing concern. Overweight and obesity have become a global epidemic and are increasing rapidly in both childhood and adolescence (Williams et al., 2002). Several reports show increasing rates of obesity in developed countries, whereas the extent of the problem in developing countries remains unknown (De Onis and Blossner, 2000).

The calculated global prevalence of overweight and obesity in children aged 5-17 years is estimated by the International Obesity Task Force (IOTF) to be approximately 10 per cent, with prevalence ranging from over 30 per cent in America to less than two per cent in sub Saharan Africa (Lobstein et al., 2004). India also is in the midst of the rapidly escalating ‘epidemic’ of childhood obesity. It is indeed ironic that a problem of "plenty" *viz*., childhood obesity, has emerged while we are still fighting undernutrition and infectious diseases (Bhave et al., 2004).

In India, it was basically undernutrition, which attracted the focus of health workers where childhood obesity was rarely seen. But over the past few years this entity is increasingly being observed. The changing life style of families in the so called modernized India with increased purchasing power, easy availability, more comfortable and luxurious living, and improved technology has all attributed to this problem. Increased hours of inactivity due to increasing academic pressure, television,

video games and computer have all replaced outdoor games and other social activities (Singh and Sharma, 2005).

Traditionally, a fat child is considered as an ‘attractive’ child, and is often referred to as a ‘healthy’ child. However, the adverse and serious consequences of childhood obesity are now proven beyond doubt (Lobstein et al., 2004)

Although the long-term effects of overweight and obesity on morbidity and mortality in children have not yet been well documented, several studies suggest that obesity in childhood is followed by serious consequences in adulthood. Childhood obesity often tracks into adulthood and which in turn increases the risk of non communicable killer diseases and premature death in adulthood. Conditions like dyslipidemia, elevated blood pressure and abnormal glucose metabolism/insulin resistance seen frequently in adults is encountered in obese children too. The physiological distribution of body fat is an important determinant to health especially in terms of development of chronic diseases. Other health consequences of obesity in children include sleep apnea and orthopedic complications while adolescents are likely to suffer considerable psychological effects as well as social stigma and discrimination. In addition to these, a few other problems associated with overweight and obesity includes cushing syndrome, hypothyroidism, insulinoma, craniopharyngioa and other hypothalamic disorders. Childhood obesity can also lead to adult obesity and associated pathogenic consequences like insulin resistance and type 2 diabetes, reproductive disorders, cardiovascular disease, pulmonary disease, gall stones, cancer, increased risk of osteoarthritis and skin problems like acanthosis nigricans (NFI, 2003).

Thus the increasing prevalence of childhood obesity and associated chronic diseases and psychosocial problems in developing countries like India is considered to day as the “New World Syndrome” creating an enormous socio-economic and crucial public health concern.

Overweight and obesity is considered as a multidimensional syndrome requiring multifaceted treatment of which dietary management and physical activity have a strong role to play. The process of obesity management covers a spectrum of strategies ranging from prevention through weight maintenance and management of

obesity related co-morbidities to weight loss. Physical activity and dietary factors are considered to be the major modifiable factors contributing to excess weight gain which, if corrected in a scientific manner over a period of time can help prevent obesity. Therefore, the only way to keep off obesity is through a life long behaviour modification involving regular physical activity balanced with a healthy diet (Chandrasekhar, 2004).

The detrimental effects of obesity viz. chronic risk morbidity and mortality risk, psychosocial consequences, hazards and complexities of medical and pharmacological treatment, severe dietary management- all argue for prevention of excessive weight gain from childhood itself. Public awareness creation along with diet counselling and behaviour modification can play an important role in the prevention and management of overweight and obesity (Kapil et al. 2002).

Rationale for the study

India is a country still combating with malnutrition due to severe undernutrition and communicable diseases. But, Kerala on the other hand has an admirable health status comparable to the West. However, the state is now going through an epidemiological transition where non-communicable diseases and malnutrition are more prevalent. The 'nutritional transition' and the lifestyle changes are also becoming relevant among children and adolescents. The popularity of 'fast foods', hotel foods, fizzy drinks, sedentary lifestyles, increased 'pocket money', lack of physical activity, increased sedentary habits like TV and computer watching and busy life style of working parents have all led to a new life style among children and youth, the effects of which are yet to be studied. There is also paucity of data on overweight and obesity in Kerala, especially about the magnitude of the condition and the problems associated with it among children. Hence a systematic and scientific appraisal on the causes and consequences of overweight and obesity in children will help to reinforce the importance of effective management of the condition. Such an effort will also prompt all concerned authorities to initiate proper measures to prevent childhood obesity. Investing into the health and welfare of the children is a cost effective way to improve the health and wealth of the nation.

The present study is therefore undertaken with the major objective to assess the “contributing factors and related problems due to overweight among rural and urban school going children of 10–15 years of age group selected from Thiruvananthapuram educational District and to find out the impact of diet counselling”.

2. REVIEW OF LITERATURE

The present investigation is carried out with a view to understand the contributing factors and problems associated with overweight among rural and urban school children and to find out the impact of diet counselling. A brief review of the relevant literature is attempted here. The review is classified into different sections for clearer perception. The different sections under which review is presented are.

2.1 Overweight and obesity – Definition

2.2 Obesity – A Global Epidemic

2.3 Prevalence of childhood overweight/obesity in India

2.4 Measurement of overweight/obesity

2.5 Theoretical Concepts on obesity

2.6 Factors contributing to obesity

2.7 Obesity related problems

2.8 Prevention and management of overweight/obesity

2.1 Definition of Overweight and Obesity

Obesity is defined as a condition of abnormal or excessive fat accumulation in adipose tissue, to the extent that health may be impaired. It represents an energy imbalance resulting from an excess of energy input (from food) over energy output or energy expenditure. A state of energy balance is needed to maintain a healthy body weight (WHO, 2000).

Obesity is a condition characterized by an excess accumulation of adipose tissue due to the enlargement of the fat cell size (hypertrophic obesity) or an increase in fat cell

number (hyperplastic obesity) or a combination of both (Williams, 1993). A child is considered as obese when the total body weight is more than 25 percent fat in boys and 32 percent in girls (Bellizzi, 2001).

Obese children are defined as those above 95th percentile of percent body fat (PBF) in each age and gender specific group. When weight for stature or weight for height in children is above 85th percentile they are considered as overweight. Overweight children may be at risk for obesity if the weight for stature or weight for height is above 95th percentile (Fu et al., 2003).

Overweight is defined as relative weight up to 10 per cent above normal (25 to 30 kg/m2) and obesity is defined as the relative weight 20 per cent above ideal body weight (> 30 kg/m2). Even a small excess in energy intake over energy expenditure (25kcal/day) over a period of time can lead to obesity. Hence obesity is a mismatch between energy intake and energy expenditure (Elizabeth, 2007).

2.2 Obesity - A Global Epidemic

The definitions of overweight and obesity in children differ between epidemiological studies, making comparisons of cross-sectional prevalence data difficult. Nevertheless, several studies have examined change in prevalence within populations over time, and the results of these analyses are astounding.

According to WHO (2003) more than 1 billion adults are overweight and at least 300 million of them are clinically obese. The United States has the highest rates of obesity in the developed world. From 1980 to 2002, obesity has doubled in adults and overweight prevalence has tripled in children and adolescents (Ogden et al., 2006).

Prevalence rates have increased 2·3-fold to 3·3-fold over about 25 years in the USA. In the USA, prevalence rose more than twice as fast among minority groups compared with white groups, exacerbating pre-existing racial-ethnic disparities (Strauss and Pollack, 2001).

Childhood obesity is already epidemic in some areas and on the rise in others. An estimated 17.6 million children under five are estimated to be overweight worldwide. According to the US Surgeon General, in the USA the number of overweight children has doubled and the number of overweight adolescents has trebled since 1980. The prevalence of obese children aged 6-to-11 years has more than doubled since the 1960s. Obesity prevalence in youths aged 12-17 has increased dramatically from five per cent to13 per cent in boys and from five per cent to nine per cent in girls between 1966-70 and 1988-91 in the USA. The problem is global and increasingly extends into the developing world (WHO, 2003).

According to WHO (2000) at least 50 per cent of adults and 20 per cent of children in U.K. and U.S.A. are currently overweight. Prevalence of overweight amongst Australian children has increased from 11 per cent in 1985 to 20 per cent in 1995. Childhood obesity has tripled in Canada in last 20 years

Canada has one of the highest rates of childhood obesity among children in the world. One in four children aged 7-13 are overweight. 33 percent of boys are overweight and 10 percent are obese, while 26 percent of girls are overweight and nine percent are obese (Filozof et al ., 2001). Prevalence rates have increased 2·0-fold to 2·8-fold over 10 years in England, and 3·9-fold over 18 years in Egypt.

Magarey et al., (2001) have reported that approximately 20 percent of Australian children and adolescents are currently overweight or obese. And about half of European adults will be obese by 2030, partly because of an emerging epidemic of obesity among children and adolescents. In Chile, 30 percent of children are overweight or obese (DeOnis and Blossner, 2000).

As with western countries, the rate of obesity, particularly childhood obesity is rising alarmingly in Asian and African countries too. The rise in childhood obesity in Malaysia, Japan, and China is evident from the studies done by Wang et al., (2002). In Malaysia, where obesity was once relatively rare, a survey done 1998 survey shows that nearly 17 percent of Malaysian boys and eight percent of Malaysian girls are obese. In the National Survey of Primary and Middle Schools in Japan, between 1970 and 1997,

obesity in nine year-old children increased three-fold. Further, in Shanghai, China, seven percent of children are obese, a six-fold increase in 10 years. Obesity is highest in the wealthiest, city-dwelling Chinese, where one in every ten children is considered obese.

Obesity does not seem to have spared developing countries either. Thailand, Iran, Nigeria and Brazil have all reported unprecedented levels of obesity with trends that are substantially rising every year. For example, in Thailand the prevalence of obesity in 5-to-12 year olds children rose from 12.2 per cent to 15.6 per cent in just two years (WHO, 2003).

2.3 Prevalence of Childhood Obesity in India

Childhood obesity is a growing problem in India also. In India, it was basically undernutrition, which attracted the focus of health workers where childhood obesity was rarely seen. But over the past few years this entity is increasingly being altered.

A survey done by DeOnis and Blossner (2000) in various cities of India has revealed the fact that 30 per cent of all obese adults identified were obese as children. According to a study conducted by Kapil et al. (2002) in Delhi, the overall prevalence of obesity was 7.4 percent in children from affluent families.

In another study from Chennai, Ramachandran, et al., (2002) reported that 17.8 per cent boys and 15.8 per cent girls were overweight, while obesity was reported in 3.6 per cent boys and 2.7 per cent girls. Studies done by Popkin (2003) on school going children of Hyderabad showed that 18 per cent of them as obese. Ramnath (2002) has reported that in a study done in 1500 school children of Meerut UP, nine per cent of them were found to be obese.

In a study by Reddy, et al., (2002) more than 28 per cent of adult males and 47 per cent of adult females in urban Delhi were overweight by WHO standards. In the same study the corresponding figures for overweight in a neighbouring Haryana rural area were seven per cent in males and nine per cent in females.

In a Delhi school with tuition fees more than Rs. 2,500 per month, the prevalence of overweight was 31 per cent, of which 7.5 per cent were obese. In Pune the figures for overweight children are 24 per cent in a well off school and six per cent in a 'corporation' school (Kapil et al., 2002). In a survey conducted by Popkin (2003) in all the five metros of Delhi, Mumbai, Chennai, Hyderabad and Kolkata it has been noticed that one out of every five-school going children are over weight.

Marwaha et al. (2006) reported that the prevalence of obesity in India today stands comparable to United States NHANES II data in 1976-1980 survey, when the prevalence of obese in USA was 6.5 per cent for children aged 5-11 years and five per cent for children aged 12-19 years. And if this trend continues, the prevalence of overweight and obesity in India also will continue to double or triple in proportions in a couple of centuries like the developed nations.

Kerala is also undergoing an epidemiological transition with increasing prevalence of this modern day epidemic. There have been few documented studies on obesity among the 9-14 age groups in Kerala. According to a study done by Ramachandran (2002) on 1000 adolescent children of Trivandrum, Kerala 5.5 percent of them were found to be obese. This study done at the Achutha Menon Centre for Health Science Studies showed a marked difference in obesity prevalence in government and private schools, indicating that obesity was linked to family income, the higher the income group the higher the chances of children becoming obese. Obesity among children in private unaided schools was 7.2 per cent, while in government schools this was 4.9 per cent.

A study conducted by Geetha (2003) paediatrician, Sree Avittom Thirunal (SAT) Hospital Trivandrum, among 3,000-odd high schoolgirls in the district, from both government and private schools, indicated that in the district 7.5 per cent were either obese or overweight. The overall prevalence of obesity was 2.2 per cent. In the city schools, obesity was 4.2 per cent while in government schools it was only 1.1 per cent.

If this increase in the prevalence of overweight and obesity continues, in another 10 yrs the number of obese children is going to double. And very soon this modern day's disease of obesity can spread to rural India and down the line in another two decades even India could become a nation of heavy weights just like today's USA.

2.4 Measurement of overweight/obesity

Overweight and Obesity is mainly assessed by three major standard methods in a normal clinical setting. a) Anthropometry b) Skin fold Measurements and c) Estimation Body Fat.

Various methods have been suggested to classify children into various nutritional grades using anthropometric measurements like weight, height and body circumferences. The most widely used methods are weight for age, and weight for height, BMI, waist circumference, waist –hip ratio etc. (Ramnath et al., 1993).

Reports by WHO (1998) indicate that Body Mass Index (BMI) is a good indicator of nutritional status which can be used to screen for both overweight and obesity. It is a more accurate indicator and measurement of choice used by many obesity researchers and health professionals. BMI is calculated by dividing a person's weight in kilograms by height in meters squared (wt in (kg)/ht in m2). WHO (1998) identified overweight as BMI of 25-29.9 and obesity as BMI of 30 or above.

According to Higgins et al. (2001) waist circumference is a highly sensitive and specific measure of central obesity. Cut off values for risk is 102 cm in adult males, 88 cm in adult females, and 71 cm in pre-pubertal children. Bhave et al., (2004) has reported that even though the markers like waist circumference and Dual energy X-ray absorptiometry (DEXA) have their individual advantages, none of them are really standardized as of yet for children.

Dwyer and Blizzard (1996) pointed out that Waist Hip Ratio or Waist circumference / Hip circumference > 0.9 indicates central obesity. It has no added advantage over waist circumference in assessing central obesity.

Skin Fold Measurements can also be used for the assessment of obesity. Using the skin fold callipers subcutaneous fat can be calculated from the measurements made at several places, such as the triceps, the abdomen, and sub scapular and sub costal sites. The sum of the above three measurements gives a better index of the subcutaneous fat than any one of them (Swaminathan, 2005). According to Dwyer and Blizzard (1996) skin fold thickness by itself has not been validated as a marker of obesity in population studies. Disadvantages of skin fold thickness is that it has significant inter and intra-observer variation, affected by gender and ethnicity, and also does not have any significant advantage over BMI.

Williams (1993) reports that there are various other methods like bioelectrical impedance analysis, densitometry (underwater weighing), computerised tomography (CT), magnetic resonance imaging (MRI), Dual energy X-ray absorptiometry (DEXA), Air displacement plethy-smography (BOD-POD) etc. for determination of body fat and general body composition to quantify the degree of obesity.

Dual Energy X-ray Absorptiometry (DEXA) accurately estimates whole-body as well as regional bone mineral density, lean mass, and fat mass over a wide range of ages and body sizes. It is non-invasive, minimal radiation, but very expensive and not practical for epidemiological studies (Otiv et al., 2004).

According to Dwyer and Blizzard (1996) the cut off values for body fat percentages for obesity is >25 per cent in adults males and >35 per cent in females. And the cut off value for obesity for girls is 30-32 per cent fat and for boys 20-25 per cent fat.

Air displacement plethy-smography (BOD-POD) is a sophisticated new technique. This is accurate, non-invasive, comfortable but very expensive. It is not suitable for younger children as it needs considerable co-operation (Bavdekar et al., 2004).

Other methods like densitometry, CT, MRI etc. are very expensive and not practical in epidemiological studies on large sample. On the other hand, Bioelectrical Impedance Analysis (BIA) method of estimating body fat using a body fat analyzer is a more practical, reliable and less expensive method. It involves the measurement of the extent to which the person's body impedes the flow of electric energy when it is introduced at several body points. The resultant reading of resistance is used by the

analyser to compute the fat free mass and by taking the difference from the total percentage, body fat percentage is computed (Williams, 1993).

2.5 Theoretical Concepts on obesity

2.5.1 Set Point Theory

According to Srilakshmi (2003), each person has an ideal biological weight or set point. Once body weight reaches this point, a whole set of signals is produced that influences the person's food intake to maintain his weight. Research has shown that risk for medical problems is related to the size of the fat cells present more than the number of fat cells or the person's weight.

2.5.2 Fat cell Theory

Early childhood and early stages of puberty are critical periods during growth for the development of obesity. A significant physiological factor in obesity is fat cell increase. Normally, number of fat cells is determined early in life and this full genetic complement of fat cells is reached by puberty and then remains constant. After puberty these cells may increase in mass within limits, but not usually in number. However, if overeating continues after the fat cells have reached their maximal capacity, cell proliferation is triggered again, and once this proliferation has occurred it cannot be reversed. In extreme obesity, for example the fat cells may increase from a norm of 30 billion to apparently 120 billion, each of which is also increased in size. Once the body has added fat cells to accommodate extra fuel storage, these cells remain and store varying amounts of fat (Williams, 1993).

2.5.3 Thrifty gene hypothesis

Elizabeth (2007) is of the opinion that during earlier periods of human development, some individuals store up energy as fat. During periods of malnutrition, those who store up energy as fat overcome successfully, whereas those who lack this capacity become victims of malnutrition. Thus, those with a 'thrifty gene' have a survival advantage. But, in affluent societies with surplus food supply, storing up of energy as fat may lead to problems like overweight and obesity.

2.6 Factors contributing to obesity

Obesity is a disease of multiple etiologies characterized by excessive accumulation of adipose tissue in the body. Many factors are said to be the reasons of obesity in children as well as in adolescents.

In 1998 the World Health Organization designated obesity as a global epidemic. The obesity epidemic, which is seen in both adults and children, is the result of various societal and environmental factors that promote weight gain (WHO, 1998).

A review of the research studies done in obesity throws light on to the many factors that may lead to childhood obesity. Both genetic and environmental factors were identified as the etiology of overweight and obesity in children and adolescents. The urban poor in developed countries are particularly vulnerable to obesity because high fat, energy dense foods are easily accessible and comparatively cheaper (James, 1996) and also they have limited opportunity for physical activity (Gorden et al., 2000).

2.6.1 Genetic-Metabolic Factors

One school of thought is that obesity is hereditary and a genetic history of obesity in family can lead to obesity in children. Genetic factors can have a great effect on individual predisposition; however, rising prevalence rates among genetically stable populations indicate that environmental and, perhaps, perinatal factors underlie the childhood obesity epidemic (Lusting, 2001).

Robert et al. (1997) reported that the risk of adult obesity was greater at any age in both obese and non-obese children if at least one parent was obese. This effect was most pronounced in children aged less than ten years.

Parental obesity is identified in India also as one of the reasons for childhood obesity. Ramachandran (2002) has pointed out that obesity in children was found to be clearly linked to parental and sibling obesity. In his study the fathers of 10.9 per cent children and the mothers of 13 per cent children were obese.

Montague et al. (1997) have reported that two massively obese Pakistani children were found to have a mutation in the gene encoding leptin, a hormone normally produced

by adipocytes and secreted in proportion to body-fat mass. Leptin increases rate of fat cell metabolism or it is called a fat burning hormone.

Whitaker and Dietz (1998) advanced the intriguing hypothesis that prenatal over nutrition might affect lifelong risk of obesity. According to this hypothesis, maternal obesity increases transfer of nutrients across the placenta, inducing permanent changes in appetite, neuroendocrine functioning, or energy metabolism.

Results of studies in animals by Levin and Govek (1998) show a direct relation between maternal obesity, infant birth weight, and adult obesity; however, the relative contributions of shared maternal genes versus intrauterine factors are difficult to differentiate. The off springs of female rats with long term diet-induced obesity were heavier than the offspring of rats with the same genotype but without obesity.

Lipoprotein Lipase (LPL) is an enzyme that helps to break down and clear lipids from blood circulation. Investigators indicate that it is possible that a defect in the LPL gene contributes to obesity because of the central role of LPL in breaking down fats to be used as fuel (Williams, 1993). The implications of these findings are formidable: the obesity epidemic could accelerate through successive generations independent of further genetic or environmental factors.

2.6.2 Perinatal, and early-life factors

According to a Dutch famine cohort study by Ravelli et al. (1976), undernutrition at important stages of foetal development can also induce permanent physiological changes that result in obesity. For this reason, the nutrition transition, as described by Popkin (2003), could place children in developing nations at particularly high risk of obesity. In view of these possibilities, an opportune time to initiate obesity prevention might be before conception.

According to Gillman et al. (2001) children who were bottle-fed seem to be more at risk of obesity later in childhood than those who were breast-fed. The explanation for this finding could relate to permanent physiological changes caused by some intrinsic factor unique to human milk or to psychological factors, such as locus of control over feeding rate (baby versus parent) or taste preference (VonKries et al., 1999).

2.6.3 Socio-demographic Factors

Social and environmental factors associated with obesity include cultural and family food patterns, job environments, recreational eating that encourage energy dense foods, the social role of eating, the sedentary patterns of recreation and employment, and television viewing time with its inactivity and constant snacking (Srilakshmi, 1993).

In India there is a tremendous 'Urban/Rural' and 'Rich / Poor' divide of obesity/overweight prevalence in the urban rich being much higher than in rural areas and poor communities. With improving standards of living, and availability of food in plenty, the upper class societies of India in recent years have urbanized to western levels (Bhave et al., 2004).

2.6.3.1 Socioeconomic Status

Two decades ago itself Grundy (1993) had observed a powerful inverse relation between obesity and socio-economic status in the developed world. According to Nutrition Foundation of India (NFI, 2003) nearly a third of the males and more than half of females belonging to what may be termed the 'upper middle class' in India are currently overweight (BMI>25). The prevalence of abdominal obesity in this group is even higher. Assuming that the 'upper middle class' in India number around 100 million (half the number of middle class), it may be anticipated that there are roughly 40 to 50 million overweight subjects belonging to the upper middle class in the country today.

The difference between the rich and the poor in children is fairly evident in urban studies. Ramachandran, et al., (2002) studied children from six schools in Chennai, two each from high, middle and lower income groups. Prevalence of overweight in low, middle and high socioeconomic group was 4.2 per cent, 13.9 per cent and 23.5 per cent respectively for boys and 5.0 per cent, 17.6 per cent and 21.5 per cent respectively for girls. That is, the prevalence of overweight and obese adolescents ranged from 23.5 per-cent in better off schools to 4.2 per cent in lower income group schools. A study by Marwaha et al., (2006), in children from the same age category (13-18years), the prevalence of overweight in Lower Socio Economic Status (LSES) and Upper Socio

Economic Status (USES) is 2.seven per cent and 17.9 per cent for boys and is 2.7 per cent and 19.1 per cent for girls respectively which is similar to data reported by Ramachandran et al., (2002).

NFI (2003) has reported that out of 4300 children in middle and upper class families of Delhi, 26 per cent were found to be overweight and 3.9 per cent were found to be obese. According to the study by Tandom et al., (2006) among overweight and obese children in Delhi, the overall prevalence of overweight and obesity among the Lower Socio Economic Status (LSES) school boys was 2.66 per cent and 0.42 per cent respectively, while that among boys from Upper Socio Economic Status (USES) was significantly higher at 16.75 per cent and 5.59 per cent respectively. Similarly, the prevalence of over-weight and obesity among the LSES school girls was 2.14 per cent and 0.28 per cent as compared to 19.01 per cent and 5.73 per cent respectively among girls from USES.

According to a study done by Subramanya et al.(2003) among affluent adolescent girls aged 10-15 years in Chennai the prevalence of overweight and obesity were found to be 10 percent and six percent respectively. In the study by Marwaha et al. (2006), in a comparable age group, the prevalence of overweight and obesity in Upper Socio-Economic Status (USES) is 20.27 and 4.76 per cent respectively.

Children from Upper Socio Economic Status (USES) were significantly taller and heavier and consequently had a significantly higher BMI compared with their age matched counterparts from Low Socio Economic Status (LSES). A higher prevalence of overweight and obesity were seen in higher income groups (Singh et al., 2006).

Childhood obesity is most frequent in upper socio-economic strata of developing nations, where over-nutrition and undernutrition coexist, probably owing to adoption of an increasingly Western lifestyle (Doak et al., 2002). Singh and Sharma (2005) is of the opinion that the changing life style of families in the so called modernized India with increased purchasing power, easy availability of items, more comfortable and luxurious living, and improved technology has all attributed to this problem of childhood obesity.

Increased hours of inactivity due to increasing academic pressure, television, video games and computer have all replaced outdoor games and other social and physical activities.

2.6.3.2 Sex

Many studies that are done in India as well as abroad points out that the prevalence of overweight and obesity varies with each sex. According to a study done by Kapil et al.(2002) in Delhi the prevalence of obesity was found to be lower among girls (six per cent) as compared to boys (eight per cent).

But a study done by Mudur (2003) in Mumbai has given a contradictory result. It was found that more girls are overweight and obese (65 per cent) than boys. Marwaha et al. (2006) also highlights the higher prevalence of overweight in girls compared to boys. Prevalence of overweight among upper socio economic status school girls was significantly higher at 19.01 per cent compared to 16.75 per cent for upper socio economic status school boys. In a study from Pune by (Khadlilkar and Khadilkar, 2004), the overweight and obesity prevalence in boys aged 10-15 years was 19.9 per cent and 5.75 per cent respectively which is comparable to data reported by Marwaha et al., (2006).

2.6.3.3 Region

Region or the place from where the child hails also seems to have an influence on childhood obesity. Studies suggest that the rate of childhood obesity is comparatively higher in urban areas than in rural areas. As early as in (1989) Gross and Monterio had reported that overweight and obesity is more prevalent in urban population, particularly among higher socioeconomic groups.

School surveys done by Mudur (2003) in Indian cities showed that 30 per cent of adolescents from India's higher economic group are overweight. He also reported that 14 per cent of the urban school children are overweight. According to Bhave et al. (2004) at

least 1 in 10 urban middle class children in India is overweight. Only community-based approaches can address such large numbers of affected children.

2.6.3.4 Age

The age of the child also seems to have an influence on the onset or rate of obesity. The crucial periods for persistence of obesity appear to be gestational period, adiposity rebound age (5-7 yrs), and adolescence (Parsons et al., 1999).

A number of studies have shown that high birth weight is positively related to subsequent fatness but higher prevalence of obesity is also seen in lower birth weights– the U or J shaped relationship (Curhan et al., 1996). The tendency for indicators of adiposity such as BMI to fall around the age of one year, and then increase again by around 5th year is referred to as 'adiposity rebound'. It is now evident, that earlier the rebound the greater the risk of subsequent obesity, although what drives the timing of adiposity rebound remains obscure (Dorosty et al., 2000). However, the most important predictor of adult obesity appears to be adolescent weight and changes of BMI during this time (Power et al., 1997).

A significant point brought out by the study by Grewal et al. (2006) in Delhi schools is the fact that overweight and obesity start manifesting as early as five years of age. At the time of entry to school at five years about nine per cent of boys and girls were overweight and about five per cent were obese. Data suggest that any intervention planned to combat the menace of obesity in childhood should begin very early in life.

Children as young as five years of age started showing an increase in BMI, with nine per cent being overweight and eight per cent obese in this age group. Among the different age groups, 11-13 years old Upper Socio Economic Status (USES) boys (19.5 per cent overweight) and 9-11 year old USES girls (20-23 per cent) showed higher prevalence of overweight compared to other age groups (Tandom et al., 2006).

A recent study done by Nutrition Foundation of India among 5000 children aged 4-18 years in a Delhi private school found 29 per cent of them as overweight with a body

mass index above 25 (Chatterjee, 2002). These studies point towards the fact that obesity among children in India is becoming a public health problem (Kumar, 2004).

Studies show that at least 30 per cent of obesity begins in childhood. Conversely, 50 to 80 per cent of obese children become obese adults (Styne, 2001). Longitudinal studies by Guo et al.(2000) also have demonstrated convincingly the substantially higher risks of child onset obesity.

2.6.3.5 Food Consumption Pattern

The trend of increasing overweight and obesity in children may be the result of environmental and cultural changes related to physical inactivity, sedentary life style and altered eating patterns with more fat content in the diet (Grundy, 1993). According to Chandrasekhar (2004) overeating during infancy, childhood and adolescence predisposes to overweight/obesity during adulthood. Abdominal obesity in particular has been a greater problem in India, apart from general obesity and is often related to eating habits of growth period. Closely related to eating habits of this age group are the present day life style, catering industry and developments in food technology.

Mudur (2003) observed that in Malaysia doctors are blaming high fat intake and sedentary life styles for fueling urban and rural rise in obesity. A study done by him involving 12000 children showed that 80 percent of their leisure time was spent watching television or indoor games. He also observed that there has been a significant increase in the consumption of fats and energy dense foods with concurrent reduction in physical activity. The risk of overweight and obesity in India is highest in the 20 percent of the population that consumes 80 percent visible dietary fat.

Traditional micronutrient rich foods in India are being replaced by energy dense highly processed micronutrient poor foods with greatly increased portions. High calorie snacks, junk food revolution, cool cola colonization, and food as rewards or demonstration of love are all part of new life styles. All Indian celebrations and festivals are also centered on rich foods (Bavedkar et al., 1999).

Kapil et al. (2002) emphasized in his report that with affluence there is a tendency to enhance the consumption of costly fatty items and oils. Gillman et al. (2000) has found out that a bedroom television increases viewing by 38 min per day. By contrast, eating family dinner seems to decrease television viewing and improve diet quality (less saturated and trans fat, less fried food, lower glycaemic load, more fibre, fewer soft drinks, and more fruits and vegetables).

Taras and Gage (1995) reported that children seem to passively consume excessive amounts of energy dense foods while watching television. Furthermore, television advertising could adversely affect the dietary patterns and habits of children. Moreover, television viewing during mealtime is inversely associated with consumption of products not typically advertised, such as fruits and vegetables.

2.6.3.5.1 Fast food

French et al. (2001) is of the opinion that the rise in consumption of fast foods, in developed and developing nations, might have particular relevance to the childhood obesity epidemic. Fast food typically incorporates all of the potentially adverse dietary factors, including saturated and trans fat, high glycaemic index, high energy density, and, increasingly, large portion size. Additionally, these foods tend to be low in fibre, micronutrients, and antioxidants and thus have increased risks of cardiovascular disease and diabetes. He also suggested an association between fast-food consumption and total energy intake or bodyweight in adolescents and adults. Adolescent girls who ate fast food four times a week or more consumed about 185–260 kcal per day more than those who did not. A large fast food meal (double cheeseburger, french fries, soft drink, dessert) could contain 2200 kcal, which, at 85 kcal per mile, would require a full marathon to burn off.

2.6.3.5.2 Energy density

As reviewed by Rolls (2000), energy density affects the satiety and food consumption, at least in the short term. According to Gibson (2000) the energy density of children's diets is directly associated with not only fat but also a range of starchy

foods, including breakfast cereal, bread, and potatoes. According to Zoumas et al. (2001) children consume more energy when meals are eaten in restaurants than at home, possibly because restaurants tend to serve larger portions of energy dense foods.

Jequier (2001) reported that fat is the most energy dense macronutrient, excessive consumption is often believed to cause weight gain. Findings of studies done by Atkins and Davies (2000) in US children do not consistently show an association between dietary fat and adiposity in children and young adults. Moreover, the prevalence of obesity was found to be directly proportional to the total calorie intake per day.

Results of a cross-sectional study by Ludwig et al., 1999 showed that total energy intake was about 10 per cent greater among school-age children who consumed sugar - sweetened soft drinks than in those who did not. They have found that consumption of meals composed predominately of high glycaemic index foods induces a sequence of hormonal events that stimulate hunger and cause overeating in adolescents.

2.6.3.6 Physical Activity Pattern

Studies carried out in India and abroad emphasize the fact that the life style and physical activity pattern of the children can make them fat or obese. A lifestyle characterized by lack of physical activity and excessive inactivity (particularly television viewing) might cause obesity in children. Findings of a cross-sectional study by Trost et al. (2001) suggest that obese children in South Carolina spent less time in moderate and vigorous physical activity than their non obese counterparts. In a nationally representative cross-sectional study in the USA, children who engaged in the least vigorous physical activity or in the most television viewing tended to be the most overweight.

Hernandez et al. (1999) reported that among children from Mexico City, obesity risk decreased by 10 per cent for each hour per day of moderate-to-vigorous physical activity, and increased by 12 per cent for each hour per day of television viewing. Also, physical activity was inversely associated with BMI change in girls, and media time (watching television or videos, playing video or computer games was directly associated with BMI change in both sexes.

According to Robinson (1998) television viewing is thought to promote weight gain not only by displacing physical activity but also by increasing energy intake. Otis et. al. (2004) is also of the opinion that sedentary pursuits like TV and movie watching, video games, internet gazing and telephone gossip sessions are now important activities of Indian children. TV also influences through heavy marketing of colas and other fatty foods. The number of TV sets and telephone connections in the home are also considered as a contributing factor in the development of obesity.

In an experimental study by Ramachandran et.al (2002) in Chennai, measures of adiposity increased significantly over an academic year in children in a control school who continued to watch television at their usual rates, compared with children in an intervention school who decreased television viewing by about 40 per cent. According to a study done by Popkin (2003) about a third of the surveyed children of selected Indian schools had a BMI at or above the 85th percentile. Children who watched TV for two or more hours per night had higher BMIs than those who watched for less than two hours, and those who drank three or more sodas per day had higher BMIs than those who drank less than that quantity.

According to Bhave et al. (2004) an important factor for obesity in India is the intense competition for admissions to schools and colleges with flourishing tuition classes right from nursery levels. Children are forced to use their play time for additional studies. Games or physical training sessions are restricted or non existent in many schools. Some schools do not have any playgrounds at all. He also reports that due to unsafe roads children are discouraged from walking or cycling to school. Motorized vehicles are popular and they are perceived to be quicker and safer for transport. Erosion of open spaces for exercise, inadequate play areas and lack of parental time to supervise play are all part of new obesogenic lifestyles. As against food as rewards, ironically exercise is meted out as a punishment - ‘100 sit ups,’ ‘run round the field.

According to a study done by Ramachandran (2002) in overweight children of Trivandrum, only 12 per cent of the adolescents engaged in regular physical activity or outdoor games, while 74 per cent girls engaged in no exercise or games at all. Thus it

can be assumed that though the reasons behind a child gaining weight could be many and are varied, lack of physical activity is one of the most common contributing factors.

2.6.3.7 Energy Balance

Wiliams (1993) has the opined that the quantity and quality of food we eat is clearly related to obesity or fat accumulation in adults as well as in children. Excess energy is converted by the body into adipose tissue and will result in overweight and obesity if the state of positive energy balance continues for long periods of time.

Lusting (2001) stated that bodyweight is regulated by numerous physiological mechanisms that maintain balance between energy intake and energy expenditure. Any factor that raises energy intake or decreases energy expenditure by even a small amount will cause obesity in the long-term. These regulatory systems are extraordinarily precise under normal conditions—e.g., a positive energy balance of only 500 kJ (120 kcal) per day (about one serving of sugar-sweetened soft drink) would produce a 50-kg increase in body mass over 10 years. Any factor that raises energy intake or decreases energy expenditure by even a small amount will cause obesity in the long-term .

2.6.4 Psychosocial Factors

Parent-child interactions and the home environment can also affect behaviours related to risk of obesity (Zoumas et al., 2001). According to a study done by Lissau and Sorenson (1994) relating psychosocial factors to dietary and physical activity behaviours that affect energy balance it was found that children who suffer from neglect, depression, or other related problems are at substantially increased risk for obesity during childhood and later in life. They also reported that reactive eating from stress or anxiety contributes to obesity.

Health-care providers with expertise in obesity treatment share these negative stereotypes to some degree (Teachman and Brownell, 2001). Overweight children as young as age five years can develop a negative self-image (Davison and Birch, 2001) and obese adolescents show declining degrees of self esteem associated with sadness, loneliness, nervousness, and high-risk behaviours (Strauss, 2000).

Risk of obesity-related complications can differ by ethnic origin and as a result of cultural factors. Black and Hispanic youths in the USA are at greater risk for type 2 diabetes and cardiovascular disease than their white counterparts (Winklby et al., 1999).

Guoss and Chumelea (1994) stated that overweight during adolescence has social, economic and psychological consequences including the effects in high school performance, college acceptance and psychosocial functioning. The odds ratio for being overweight (75^{th} percentile) at age 35 were about two to four for those who were overweight from 8 to 18 years of age.

The long term negative social effects of overweight in adolescents were highlighted in a study done by (Gortmaker et al. 1993). They reported that women who were overweight during adolescence had completed only fewer years of schooling; were less likely to marry and had lower household income.

2.7 Obesity Related Problems

Obesity is a multi system disease with potentially devastating consequences. Obesity is associated with a number of metabolic disturbances such as diabetes mellitus, atherosclerosis and various other chronic diseases (Must and Strauss, 1999). According to a Harvard study by Must et al. (1992), morbidity from cardiovascular disease, diabetes, obesity related cancers and arthritis was 50 -100 per cent higher in obese individuals who were also obese as children.

Obesity is also linked to coronary artery disease, cerebrovascular disease, orthopaedic disorders, cholilithiasis, hyperuricaemia, early pubertal changes, menstrual irregularities, respiratory infections, obstructive sleep apnea (OSA) and psychosocial problems.(Elizabeth, 2007).

2.7.1 Health Risks

2.7.1.1 Diabetes Mellitus

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia or elevated blood glucose levels due to deficiency or diminished effectiveness of insulin. Obese people are more likely to develop diabetes mellitus.

Changed life style and food habits of the population have increased the incidence of diabetes three fold in the last 14 years in India (Bhave et al., 2004). Studies by Ford et al. (1997) suggested that for every kilogram of increase in body weight the risk for developing diabetes increases 5.4 per cent.

Folsom and colleagues (2000) found that women with a low BMI had markedly elevated diabetes risk if they also had a high Waist Hip Ratio (WHR). In contrast, Chan et al. (1994) found that in men waist circumference remained a better predictor of type II diabetes risk than WHR after controlling Body Mass Index (BMI). Lean and colleagues (1998) found that among men and women with a large waist circumference (= 102 and = 88 respectively) the risk of developing type II diabetes increased 4.5 and 3.8 fold.

Type 2 diabetes, once virtually unrecognized in adolescence, now accounts for as many as half of all new diagnoses of diabetes in some populations (Fagot et al., 2000). This condition is almost entirely attributable to the paediatric obesity epidemic, though heredity and lifestyle factors affect individual risk. Of particular concern, a prediabetic state consisting of glucose intolerance and insulin resistance seems to be highly prevalent among severely obese children irrespective of ethnic group, even before formal diagnostic criteria for diabetes (Sinha et.al.., 2002).

According to Ramachandran et al. (2001), the prevalence of diabetes, Coronary Heart Disease (CHD) and other life style disorders are increasing alarmingly in India, and is affecting much younger populations than in the West. A large pool of young Indians demonstrated ‘prediabetics’ (*i.e.*, insulin resistance and or glucose intolerance).

Gestational diabetes is common in mothers. The association of these problems with high BMIs and importantly central obesity is now well accepted (Shelgikar et al., 1991).

Hyperinsulinemia or Insulin Resistance

Abdominal obesity is associated with several hormonal abnormalities such as insulin resistance and the consequent increased insulin secretion, which may occur as an adaptation to limit the further accumulation of body fat deposition and the resultant increase in body weight. Insulin resistance or diminished effectiveness of insulin in regulating blood glucose levels is a condition characterized by increased insulin production and impaired glucose tolerance and is probably the most frequent abnormality seen in association with central or visceral abdominal adiposity (Despres, 1993).

Ramachandran et al. (2001) reported that Indians have a high propensity to develop higher upper body adiposity particularly central obesity. And central obesity (in the form of huge paunch) is strongly associated with glucose intolerance than generalized obesity. Insulin resistance tends to worsen with small increase in weight and lack of physical activity. Also, for any given BMI, Indians tend to have higher insulin levels indicating pronounced insulin resistance.

Yajnik (2002) is of the opinion that obesity may not be as high in India as in the west, but the body composition and metabolism of Indians and Asians in general make them especially prone to adiposity and its consequences. South Asians have at least 3 to five per cent higher body fat for the same BMI as compared to Caucasians (Deurenberg et al., 2002).

Studies conducted in Pune by Yajnik et al. (2002) have demonstrated the ‘thin fat Indian Phenotype’ with evidence of hyperinsulinemia even at birth. The fat is typically located centrally and around visceral organs is more dangerous than peripheral fat.

Longitudinal studies done in Pune by Bavdekar et al. (1999) have highlighted the deleterious effect of accelerated weight gain in childhood ‘crossing of centiles’ especially

in LBW babies. Indices of insulin resistance and cardio-vascular risk factors were found to be highest in those who were born ‘small’ but were big by eight years in their study.

The recent Delhi study in young adults by Bhargava et al. (2004) showed that an increase of BMI of 1 SD from 2 to 12 years of age increased the odds ratio for metabolic diseases by 1.36. Insulin resistance may underlie a number of other metabolic disorders including hypertension, hyperglycemia and impaired glucose tolerance, hypertriglyceridemia, and hypercholesterolemia (Reaven and Banting, 1988). This clustering of risk factors has been termed insulin resistance syndrome, syndrome X or metabolic syndrome (Wilson et al.,1998).

Increasing central obesity has been independently associated with insulin resistance, hyperinsulinemia and a progressive increase in insulin and glucose concentration in response to an oral glucose tolerance test. Some have proposed that central obesity promotes insulin resistance through increased levels of free fatty acids which causes the muscle tissue to utilize more fat fuel, impairing the utilization of glucose. (Evans et al., 1984).

Wilson and colleagues (1998) found that weight gain over 16 years predicted development of features of the insulin resistance syndrome. However, it has been proposed that insulin resistance is an adaptation for maintaining stable weight such that the oxidation of fat tends to be favored over its storage and over the oxidation of glucose (Eckel, 1992)

In women, body fat distribution pattern often changes with the progression through menopause. Van Pelt et al. (2001) in a large cohort study of healthy postmenopausal women found that waist circumference is significantly associated with hyperinsulinemia and elevated triglyceride concentrations among women with a normal range of BMI (24-28 kg/m2). Studies thus reveal that many of these chronic health problems are found in those who had a history of childhood obesity.

2.7.1.2 Cardiovascular Risk Factors

Hypertension

Hypertension or high blood pressure is a serious health risk associated with obesity. When obesity and hypertension coexist, the chances of developing other cardiovascular complications are increased (Williams, 1993).

Estimates by Field et al. (1999) suggest that after adjustment for other risk factors each kilogram increase in body weight increases the risk for developing hypertension by 4.4 per cent. Obesity is strongly linked to several cardiovascular risk factors including diabetes, hypertension, and dyslipidemia. Childhood obesity is identified in many cases as the cause for adult obesity and associated CVD (Must et al., 1999).

Dyslipidemia

Several studies by Brown et al. (2000) have shown associations between body weight and plasma lipoproteins. Dyslipidemia can be defined as Total Cholesterol (TC) greater than 200mg/dl, LDL cholesterol greater than 130mg/dl, HDL less than 35 mg/dl. Obese people are more likely to have high blood cholesterol levels; this increases the risk of arteriosclerosis, a condition in which fatty deposits build up on the inner linings of the arteries.

Furthermore, studies by Jeppesen et al. (1997) have found that a high LDL to HDL cholesterol ratio in the presence of hypertriglyceridemia is associated with highest CVD risk. This unfavorable lipid profile is commonly found in obese adults especially those who have a history of childhood obesity.

Obesity, Coronary Heart Disease (CHD) Risk and Risk of Stroke

Several studies by Manson et al. (1990) have found a strong association between obesity and CHD risk. As with adults, obesity in childhood causes hypertension, dyslipidaemia, chronic inflammation, increased blood clotting tendency, endothelial dysfunction, and hyperinsulinaemia (Freedman et al., 1999). This clustering of

cardiovascular disease risk factors, known as the insulin resistance syndrome, has been identified in children as young as five years of age (Young et al., 2001).

Among adolescents and young adults who died of traumatic causes, the presence of cardiovascular disease risk factors correlated with asymptomatic coronary atherosclerosis, and lesions were more advanced in obese individuals (Strong et al., 1999). Furthermore, in a British cohort study by Gunnell et al.(1998), obesity in childhood increased the risk of death from ischaemic heart disease in adulthood two-fold over 57 years. Serious hepatic, renal, musculoskeletal, and neurological complications were also increasingly recognized in these children.

2.7.1.3 Cancer

Elevated body weight has been linked with increased risk of some cancers including colon, prostate, gallbladder sites and in women, cancers of the reproductive system and breast. In the Nurses' Health Study by Huang et al. (1999) central adiposity determined by waist circumference and WHR was associated with an increased risk of postmenopausal breast cancer with the greatest elevation in risk evident among postmenopausal women who were not receiving hormone replacement therapy.

Although less consistently than BMI, other measures of obesity such as waist circumference waist-to-thigh ratio and subscapular-to-tricep skin fold (a measure of central versus peripheral obesity) have been positively associated with endometrial cancer, independent of BMI. Despite the fact that endometrial cancer is less common than breast cancer, a greater number of endometrial cancer cases are attributable to obesity (Austin et al., 1991).

Cohort studies by Giovannucci et al. (1995) have consistently demonstrated a strong positive relationship between BMI and risk of colon cancer in men with weaker associations found in women. Studies by Folsom et al. (2000) found that body fat distribution, as determined by WHR or waist circumference is an important independent and strong risk factor of colon cancer independent of BMI.

Based on evidence from case-control studies by Kreiger et al. (1993), obesity represents one of the more consistently observed risk factors for renal cell carcinoma, with a more pronounced association found among women. However, a recent meta-analysis of studies by Bergstrom et al. (2001) found that 27 per cent of renal cell cancers cases among men and 29 per cent among women could be attributed to overweight and obesity. Chow et al. (2000) found that the risk of renal cell cancer was almost doubled among men with a BMI = 27.8 compared to those with a BMI = 21.8, suggesting that even small excesses in body weight increase risk among men.

Several studies report the incidence of gallbladder cancer to be positively associated with body weight particularly among women. A 13-year study by Strom et al. (1995) of 750,000 men and women found that gallbladder cancer mortality rates were significantly higher among overweight women, but not overweight men. With respect to prostate cancer, some observational studies by Giovannucci et al. (1997) have suggested that overweight are associated with an increase risk of prostate cancer.

2.7.2 Other Morbid Conditions Associated With Obesity

Several additional diseases and health risks are associated with overweight and obesity.

2.7.2.1 Gallbladder disease

Most gallstones in the developed countries are thought to be cholesterol gallstones, and their association with obesity is thought to be a consequence of excessive hepatic secretion of cholesterol, resulting in bile that is cholesterol-supersaturated (Stevens, 2000). In middle-aged men and women studied prospectively over a 10-year period, risks of the development of gallstones across obesity classes were similar for men and women. In women, obesity and adult weight gain after age 18 are each important predictors of gallstones (Grodstein et al., 1994).

According to Must et al. (1999) the relative risks of gall bladder disease among women are higher for those with BMI 27 and above. Overall, obesity has been

consistently shown to be a powerful risk factor for the development of gallbladder disease in women.

2.7.2.2 Sleep apnea & respiratory problems

Pulmonary complications including sleep disordered breathing sleep apnea, asthma, and exercise intolerance is seen in obese individuals. Development of asthma or exercise intolerance in an obese child can limit physical activity and thus cause further weight gain. In sleep apnea, the person stops breathing several times an hour for 10 or more seconds while sleeping. Too much fat in the person's neck, blocking the airway, especially during sleep could cause this. Sleep apnea can also be caused by a problem in the portion of the brain that controls breathing. People with sleep apnea do not sleep well (Redline et al., 1999).

According to Resta et al. (2001) obese patients suffer from a variety of respiratory complications such as obstructive sleep apnea (OSA), obesity hypoventilation syndrome, symptoms of dyspnea, and possibly increased risk of asthma. They also report that over 50 per cent of obese patients with a mean BMI > 40 kg/m2 were affected by OSA.

In a population-based prospective study by Katz et al. (1990) increase in BMI was associated with a fourfold increase in risk of OSA. Central obesity and increased neck circumference were also found to be important risk factors for OSA.

Several dietary intervention studies by Schwartz et al. (1991) have found that weight loss has been associated with improvements in sleep-disordered breathing. Given that OSA is an important risk factor for hypertension CVD and stroke weight loss may simultaneously reduce sleep breathing disorders and other morbid health conditions in obese patients.

2.7.2.3 Osteoarthritis

Obesity is a potent risk factor for osteoarthritis, particularly of weight bearing joints such as the hip and knee. The mechanism that may account for the observed

association between obesity and osteoarthritis is the mechanical effects on the joint of increased load (Manninnen et al., 1996).

2.7.2.4 Gastrointestinal Reflux Disease (GERD)

People who are obese are more likely than people who are not obese to have gastro intestinal reflux disease (GERD) of which heartburn is a major symptom (Swaminathan, 2005).

2.7.2.5 Cataract

Schaumberg and coworkers (2000) observed that BMI was positively associated with risk of cataract in men. Although the etiology of a cataract is multi-factorial and differs depending on its location in the lens, obesity is one potential risk factor that may influence its development. Several plausible mechanisms exist through which obesity may increase the risk of cataract. For example, elevated body weight is associated with increase blood pressure, glucose intolerance and insulin resistance, three conditions linked with the development of cataracts.

2.7.2.6 Gout

Obese persons are more to develop gout. Gout is a clinical condition in which the uric acid levels in blood and tissues are high and deposits of insoluble urates in the joints. The deposition of urate in joints leads to recurrent attacks of pain and swelling of the joints (Swaminathan, 2005).

Since plasma cholesterol levels are high in obese people they are more prone to gall bladder stones. Gout also affects more commonly obese individuals than others (Must and Strauss, 1999).

2.7.2.7 Abdominal obesity and Reproductive Function

Abdominal obesity in women is associated with an increase in free testosterone and free androstanedione levels and a decrease in progesterone levels. In men, on the

other hand, abdominal obesity is associated with a reduction in testosterone levels. These hormonal abnormalities may explain why abdominal obesity is associated with ovulatory dysfunction, hyperandrogenism, polycystic ovaries and some hormone sensitive cancers in women (NFI, 2003).

2.7.3 Other Problems Associated with Obesity

2.7.3.1 Physical Disability

Since feet will have to carry extra load, complications such as flat feet, osteoarthritis of the knee, hips and lumbar spine are common among obese people. This can severely impair the motility and severe obesity can make people bed ridden if proper measures are not taken for weight reduction (Williams, 1993)

The abdominal muscles that support the viscera and those in the legs, which help by their contractions the venous return of blood to the heart, are infiltrated with fat. Hence, their normal mechanical action is impaired with consequent abdominal hernias and varicose veins. Adipose tissue around the chest and under the diaphragm interferes with respiration and predisposes to bronchitis (Swaminathan, 2005).

2.7.3.2 Proneness to Accidents

Obese people are more likely to meet with accidents by falling down on slippery floors and while crossing busy streets (Swaminathan, 2005).

2.7.3.3 Low Life Expectancy

In view of the many hazards to their health, obese people are at high risk from the point of view of Life Insurance Companies. Statistics of Metropolitan Life Insurance Companies of USA have shown that for a man of 45, an increase of 12 Kg above the standard weight for the height reduces his life expectancy by about 25 per cent (Swaminathan, 2005).

Studies thus indicate innumerable morbid conditions and health risks associated with obesity irrespective of age and sex. Both children and adults are thus victims of these morbid conditions.

2.7.3.4 Psychosocial Problems

Findings of many studies by Hill and Silver (1995) indicate substantial psychosocial consequences of childhood obesity. Obese children are stereotyped as unhealthy, academically unsuccessful, socially inept, unhygienic and lazy.

Williams (1993) reports that there exists strong prejudice against obese persons, especially directed towards women. The public perceives fat people as having less control over their appetite and as being more responsive to external cues than to internal ones. Majority of the obese people have emotional problems associated with the condition. On the other hand reactive eating caused by stress, anxiety, depression and other emotional problems in turn can actually worsen severity of obesity.

Overweight during adolescence also has social, economic and psychological consequences including the effects in high school performance, college acceptance and psychosocial functioning. The odds ratio for being overweight (75^{th} percentile) at age 35 were about 2 to 4 for for those who were overweight from 8 to 18 years of age (Guoss and Chumelea, 1994).

The long term negative social effects of overweight in adolescents were highlighted in a study done by Gortmaker et al. (1993). They reported that women who were overweight during adolescence had completed only fewer years of schooling; were less likely to marry and had lower household income. He also observed that overweight men were less likely to get married.

2.8 Prevention and Management of overweight / obesity

According to Barlow and Dietz (1998) at least 1 in 10 urban middle class children in India is overweight. If we allow this epidemic to continue we will top the world in Diabetes and CHD earlier than estimated. The cost of treating diabetes mellitus and associated disorders alone will consume a major chunk of our resources which we can ill afford. Only community based approaches can address such large numbers of affected children. Further, results of treating established obesity at clinics are disappointing, though on a positive note children do better than adults.

Several intervention studies have found that weight loss is associated with a reduced risk for diabetes among obese or those at high risk of developing the disease. One intervention study by Eriksson et al. (1991) found that weight loss plus exercise reduced the risk of developing type II diabetes by 50 per cent in individuals with impaired glucose tolerance. Wing et al. (1998) found that a modest weight loss of 4.5 kg over 2 years, as a consequence of a lifestyle intervention including diet and/or exercise, reduced the risk of developing type II diabetes by 30 per cent relative to no weight loss.

Long-term studies have shown that interventional programmes in children are far more successful and cost effective than in adults. Obesogenic lifestyle behaviors are less well developed in children and therefore more amenable to change. An overwhelming body of evidence now indicates that prevention must begin in childhood to reduce the burden and cost of obesity in society (Lobstein et al., 2004).

In India, Public health efforts so far, have been directed towards improving nutrition. Obesity prevention campaigns will have to be carefully worded to avoid conflicting messages and deleterious results. However the only way to cut short the escalating epidemic appears to be prevention of obesity and other lifestyle problems in childhood itself (Barlow and Dietz, 1998).

The control of this epidemic is a challenge and requires strong social and political will in addition to medical management. A concerted public health approach will be required for effective prevention. The whole family, indeed the whole society must be targeted for the health of the future generation (WHO, 2003).

In India, high prevalence of obesity in children has just started. Obviously then, no intervention studies have been carried out as yet. But a number of studies have been carried out and reported from the Western countries (Gortmaker et al ., 1999).

Such interventions with a few modifications can be used in India and Kerala. Studies thus indicate that prevention through environmental, social or behavioural interventions is the logical focus in tackling this epidemic (James, 1996).

Public Health Approach: Role of Different Types of Diets and Diet Counselling in Weight Reduction

Elizabeth (2007) is of the opinion that even though many types diets like Atkins diet, formula diet, Hay diet, weight watchers diet, low fat diet, low calorie diet, high dietary fibre diet, very low calorie diet etc. are available, the important fact in any weight reduction programme is that it is relatively easy to lose weight over a short period but much more difficult to maintain that weight loss in the long term. Only improved insight, changed dietary habits, behavioural change and exercise will sustain optimal weight. One of the most important aims of any obesity management programme is to help patients recognize 'danger foods' (mainly fatty and energy dense foods) and to help them to increase their own control over eating. Calorie counting and fat avoidance can be encouraged by asking the patient to keep a food diary which can also provide insight when weight loss is not proceeding as expected.

Diet counselling should be a process of re-education or behaviour modification of the children that will affect their whole life style to maintain weight loss over the long term. As a Public Health Approach, essentially all children, adolescents and families should benefit from counselling and other life style approaches to prevent excess weight gain and obesity. Public health approach in overweight and obese children generally includes nutrition education and diet counselling of children and their parents (Epstein, 1992).

(*i*) *Healthy eating patterns:* Emphasis should be on nutrition rather than 'dieting'. It is important to maintain healthy components of traditional diets (*i.e.*, micronutrient rich food such as fruits, vegetables and whole grain cereals) and guard against heavily marketed energy dense fatty and salty foods (*e.g.,* pre-packaged snacks, ice-creams and chocolates) and the sugary cold drinks. The strategy should be to recognize and eliminate risk features of high calorie intake such as frequent snacking (samosas, potato chips, chiwdas), eating out frequently (burgers, dosas), celebrating with food (cake, chocolates) and drinks (colas, beers). Healthier alternatives can be suggested. Habits attained early have more chance of remaining throughout life (Lobstein et al., 2004).

A simple Indianised message based on recommendations of AHA could be–"think of a day's food composition as a 'Thali' wherein 50 per cent (half) is full of vegetables, salads and fruits. A quarter (25 per cent) should be made up of cereals such as rice and/or chapattis and the remaining quarter should be protein based (dal/milk/egg/animal protein)". Fried, snacks and 'sweet dishes' are only for a very few special occasions (Williams et al., 2002).

(ii) *Increase physical activity levels:* Children should be encouraged to be active not only for weight control but for general well being. Many adolescents/pre adolescents find defined physical exercises (aerobics, tread-mills) boring and punitive and are more likely to continue activity if it is incorporated into their daily routines, *e.g.*, walking or cycling to school and playing with friends on the grounds (Ikeda and Mitchell, 2001).

The WHO (2003) recommends at least 30 minutes of cumulative moderate exercise (equivalent to walking briskly) for all ages; plus for children an additional 20 minutes of vigorous exercise (equivalent to running), three times a week. These recommendations are basically for prevention of CHD and prevention of obesity requires more physical exertion. In general, moderate to vigorous activities for a period of at least one hour a day may be a more practical recommendation for all school going children.

(*iii*) *Decrease sedentary behavior:*. In India, chief sedentary behaviors are television, computers, telephone conversations all of which should be restricted to no more than 2 hours a day). Increased tuition classes also contribute to sedentary behaviour, the restriction of which may not be possible (Uauy and Kain, 2002).

In conclusion, addition of physical activity and reduction in sedentary behavior, both improve long term outcome (Edmunds et al., 2001). The important components of behavioral therapy include treatment of families as a whole, identification of problem behaviors and their modifications and `tailor' made advice and support component. Parenting skills recommended in treatment plans are praising the child's behavior, never using food as reward, establishing firm daily family meal and snack times, providing only healthy options, removing temptations and being a good role model (Epstein, 1992).

In view of the facts that the data on childhood obesity from Kerala is scant, this study was particularly planned to assess the contributing factors of overweight and various problems associated with it in school children between 10-15 years of age from selected schools in Thiruvanathapuram District of Kerala.

3. MATERIALS AND METHODS

This chapter deals with the methodology adopted for carrying out the study entitled “Contributing factors and problems associated with overweight among rural and urban school children”.

The study is undertaken with the major objective to assess the “contributing factors and related problems due to overweight among rural and urban school going children of 10–15 years of age group selected from Thiruvananthapuram educational District and to find out the impact of health education and diet counselling on weight reduction”.

The specific objectives set forth to make detailed and thorough investigation of the problem are:

i) To screen and classify the children into overweight and normal weight groups based on standard obesity indicators like anthropometric measurements and body fat percentage.

ii) To understand the influence of socio-demographic features, dietary habits and activity pattern on the weight status/adiposity in children.

iii) To estimate and compare the quantitative and qualitative adequacy of the diets of overweight children with normal weight children.

iv) To find out the knowledge, attitude and practices of the overweight and normal weight children towards nutrition, diet related diseases, physical activity and weight reduction.

v) To study the physical, health, academic, psychosocial and behavioral adjustment problems associated with overweight and obesity in children

vi) To evaluate the effectiveness of health education and diet counselling to parents and overweight children in weight reduction.

The methodology adopted for the conduct of the study is discussed under the following headings.

3.1 Locale of the study

3.2 Conduct of the study

3.3 Statistical analysis

3.1 Locale of the study

Thiruvananthapuram being the capital city of Kerala has a cosmopolitan population from the whole state. For administrative convenience and improving the efficiency of the school education the revenue districts of the state is divided in to educational districts and educational sub districts with Thiruvananthapuram educational district being one among them with more number of schools from urban, suburban and rural areas. Hence Thiruvananthapuram educational district was purposively selected to get a representative sample of rural and urban children. Once the district was chosen, rural and urban high schools having a large population of 10-15 year old students were randomly selected to get a representative sample of rural and urban school population from Thiruvananthapuram educational district.

3.2 Conduct of the Study

3.2.1 Selection of Schools

Sampling frame

Sampling frame consisted of different types of schools (Government/Private, aided/unaided, SSLC/CBSE/ICSE). However, special schools for disabled children, training schools and the schools in which the authorities were non-cooperative to the study were excluded from the study.

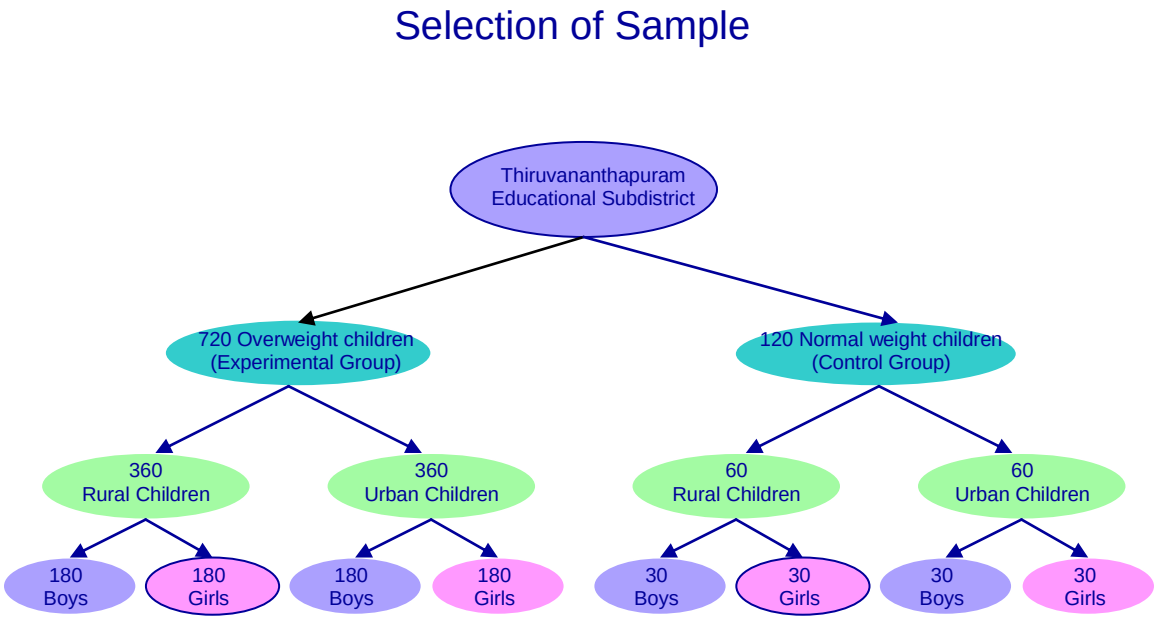
The first step consisted of identifying the different schools under the educational district of Thiruvananthapuram District from the list collected from the department of education, Government of Kerala. Schools were selected randomly from rural and urban areas giving due representation to the type of management and to the different curriculum. Care was taken to include schools with high number of children from 10-15 years of age group. Thus four schools from urban area and six schools from rural area were selected for the study. The schools selected were St. Thomas High School, St. Thomas Central School, Christ Nagar School (CBSE), Christ Nagar School (ICSE), Mary Nilayam School, Al Uthman High School, Al Uthman Higher Secondary School, Thundathil Madhavavilasam High School, St. Goretty Girls High School and Sreekariyam Govt. School. Once the schools were selected, permission was obtained from school authorities for selecting the children from their schools for the conduct of the study and convenient dates were fixed for screening and data collection.

3.2.2 Selection of Sample

Once the schools were selected, the anthropometric measurements of all the children were taken. The children were further screened for overweight and obesity and grouped age wise based on the International Obesity Task Force (IOTF) BMI cut off values suggested by Cole et al. (2000). (Appendix-I).

A total of 3886 children were screened for overweight and obesity for getting the required number of overweight and normal children from the age group of 10-15 years from 8 schools. In addition, in two rural schools, all the overweight children were gathered by the teachers in a common place for taking the anthropometric measurements, so that the routine work of the schools will not be disturbed. They were further screened and grouped age wise based on the IOTF BMI cut off values.

The final sample size was 840 with 720 overweight children in the experimental group and 120 normal weight children in the control group. Thus the sample consisted of six groups of 120 overweight children selected from each age group between 10 -15 years with 30 boys and 30 girls in each age group identified both from rural and urban areas. A control group of 120 children having normal and standard height and weight for their age was also selected so that each age group has 10 boys and 10 girls both from rural and urban schools.



3.2.3 Selection of Micro sample

A micro sample of 120 children was also drawn from the macro sample with a minimum of ten in each age group from both rural and urban areas for in-depth study. Sub sample selection was done based on cooperation of the subjects and family members. Obese children with higher BMI and body fat than others were given preference in the selection of micro sample.

3.2.4 Tools and measures used for the study

a) Screening and selection of overweight and obese children between 10-15 years through anthropometric measurements using standard tools.
b) Bioelectrical Impedance Analysis (BIA) for measuring body fat using a body fat analyzer.
c) Questionnaire to collect socio-demographic and familial information.
d) Questionnaire to collect information regarding dietary habits, food consumption pattern and food preferences of the subjects.
e) Activity-Time log to determine the time utilization and activity pattern of the subjects.
f) Weighment survey to estimate the actual food intake of the subjects
g) Laboratory analysis of the food sample to determine the macronutrient intake.
h) Determination of energy balance from energy intake and energy expenditure.
i) A suitably developed and standardized scale to understand the Knowledge, Attitude and Practices of the subjects toward nutrition, diet related diseases, physical activity and weight reduction.
j) Checklist to determine the health and physical problems related to overweight and obesity.
k) A suitably developed and standardized scale to study the academic, psychosocial and behavioural adjustment problems related to overweight and obesity.
l) Diet counselling and health education as measures to manage overweight in children.

Screening of school children for assessment of overweight

3.2.5.1 Anthropometric Measurements

Nutritional anthropometry is the measurement of human body at various ages and levels of nutritional status and this is based on the concept that an appropriate measurement should reflect any morphological variation occurring due to a significant functional physiological change. Nutritional anthropometry can be used to understand whether a person is underweight, normal weight, overweight or obese (Rao, 1996).

Various methods have been suggested to classify children into various nutritional grades using anthropometric measurements like weight, height and body circumferences. The most widely used methods are weight for age, and weight for height, BMI, waist circumference, hip circumference, waist –hip ratio etc. (Ramnath et al., 1993).

In this study height, weight, waist and hip circumference were recorded. Body Mass Index from weight and height measurements and Waist Hip ratio from the waist and hip circumferences were calculated.

3.2.5.1.1 Height

Heights of the children were measured using a stadiometer. The subject was asked to stand erect looking straight on a levelled surface with heels, buttocks, shoulders and back of the head touching the wall. The head was held erect with arms hanging at the sides in a natural manner. The moving headpiece of the stadiometer was lowered to rest flat on the top of the head and the measurement was taken. Height was read to the nearest 0.5cm. An average of three measurements was taken as the height of the respondent.

3.2.5.1.2 Weight

Body weight is the most widely used sensitive and simplest reproducible anthropometric measurement. It indicates the body mass and is a composite of all body constituents like water, mineral, fat, protein and bone. It reflects more recent nutrition (Srilakshmi, 2003).

For taking the weight of the respondent, platform-weighing balance was used, as it is portable and convenient to use in the field. The weighing scale was adjusted to zero before taking each measurement. The respondent was asked to stand on the platform of the scale without touching anything and looking straight ahead. Footwear was removed

Weight Measurement

Height Measurement

and clothing was minimal. The weight was recorded to the nearest 0.25 kg. Each reading was taken thrice to get the accurate weight of the respondent.

3.2.5.1.3 Body Mass Index (BMI)

BMI is regarded as a good indicator of nutritional status. BMI, which is expressed as a 'ratio of weight in kg to height in meter squared' is an indicator of general obesity. A person with BMI between 25-29.9 is identified as overweight and the one with BMI of 30 or above is considered as obese (WHO, 1995).

BMI can be calculated easily from weight and height and it correlates well with other measures of body fatness in children and adolescents. Hence it is considered as a useful index to assess overweight and a fairly reliable surrogate for adiposity. Therefore BMI appears to be the most practical way of measuring and comparing obesity for clinical and epidemiological purposes (Bhave et al ., 2004). Hence BMI were computed in the study to screen overweight children.

BMI values for adults are age independent and same for both sexes. However, in children, BMI changes substantially with age and sex. To have an absolute definition of childhood overweight and obesity Cole et al. (2000) have derived an age and sex specific cut off line based on BMI from the data obtained from six countries called International Obesity Task Force (IOTF) cut off values (Marwaha et al., 2006).

According to Bhave et al. (2004) the NCHS/CDC (2000) charts from USA can be used as a reference for Indian children and as per Lobstein et al. (2004), the IOTF cut off values are now recommended as standards for international comparison of data. Hence age and sex specific IOTF values were adopted for the screening and selection of overweight and obese children in this study.

A limitation of BMI is that it cannot differentiate between an obese individual and a muscular individual. It also cannot locate the site of fat e.g., people with 'central obesity' may have normal BMIs. Hence other methods like body circumference and body fat were also measured in this study to confirm overweight and adiposity in the selected children.

3.2.5.1.4 Waist Circumference (WC)

According to Higgins et al. (2001) waist circumference is a highly sensitive and specific measure of central obesity. Cut off values for risk is 102 cm in adult males, 88 cm in adult females, and 71 cm in pre-pubertal children. The children were asked to remove belts and thick clothing materials in the waist area. The circumference of the waist and hip were then taken to the nearest centimeter using a measuring tape. The waist and hip circumferences of all the children were thus recorded.

3.2.5.1.5 Waist Hip Ratio (WHR)

Waist Hip Circumference (WHR) is an indicator of the nutritional status and it reflects the proportion of the body fat located intra abdominally as opposed to that in the subcutaneous region (Srilakshmi, 2003).

Waist – hip ratio is widely accepted form of fat patterning measurement. According to Jelliffe (1976) the waist-hip ratio was calculated by dividing the circumference of the waist by the circumference of the hip. Even though no standard WHR is available for screening overweight children, WHR was particularly computed in this study for comparing the BMI of overweight/obese children with normal weight children of the control group.

3.2.5.1.6 Mid Upper Arm Circumference (MUAC)

According to Srilakshmi (2003) Mid Upper Arm Circumference (MUAC) indicates the status of muscle development. This is also one of the anthropometric measurements used to measure obesity, especially in adults. In this study, this measurement was also taken for comparison with normal weight children and standards suggested by Jellifee (1976) (Appendix –II).

For assessing the MUAC, fiberglass tape was used. On the left hand of the children, the mid point between the tip of the acromion of the scapula and the tip of the olecranon of the forearm bone was located with the arm flexed at the elbow and marked with a marker pen and the reading was taken to the nearest 0.1cm. The MUAC of the children were thus recorded.

3.2.5.2 Body Fat Percentage

Apart from anthropometry, Bio-electrical Impedance Analysis (BIA) method was also used in this study for determination of body fat and general body composition to quantify the degree of obesity. Bhave et al. (2004) is of the opinion that bio-electrical impedance analysis is a non-invasive, safe, cheap, reliable estimation of body composition using a small portable fat analyzing instrument or scale. This method is safe and more convenient and quicker to administer along with anthropometry than any other methods. Hence this method was used for finding the body fat percentage. In this study body fat percentage of the selected children was determined using the body fat analyzer employing the BIA method.

For taking the body fat percentage of the respondent, body fat analyser was used, which is a portable and convenient scale to use in the field. Height of each subject was first taken and it was entered in the fat analyzer along with the age. Respondents were asked to stand on the platform of the scale with their feet making good contacts with the metal points. The subjects were adequately hydrated and were made to stand erect on the fat analyzer scale. Care was taken to remove the footwear and the fat percentage was recorded with minimum clothing and accessories. From the digital display in the fat analyzer, body weight, body fat percentage, body mass index, hydration level and bone density of the subjects were recorded.

3.2.5 Identification of Contributing Factors

3.2.6.1 Socio-demographic and familial survey

The socio-economic features of the individuals such as social, economic, religious and the family background in general, have a very distinct part to play in determining the attitudes and food behavioural pattern of the individual (Arora, 1991).

In the present study, personal interview method was used to collect information from the respondents regarding their socio-economic back ground and family details as suggested by Swaminathan (2005). A questionnaire was therefore developed to elicit information on the socio-demographic and familial background of the subjects along with information on their personal characteristics.

The questionnaire thus consisted of questions to collect the family and environmental details like family type, family size, family income, type of house, source

of drinking water, and personal characteristics like age, sex, religion, ordinal position, birth order, and sources of information. There were also questions to know about the physical amenities of the household such as electricity and sanitary latrines. The pretested questionnaire developed for this purpose is given in Appendix-III. Using the developed questionnaire, the socio-demographic and familial details of each subject was collected by the investigator.

3.2.6.2 Dietary Survey

According to Swaminathan (2005) diet surveys constitute an essential part of any complete study of nutritional status of individuals or groups, providing essential information on nutrient intake levels, sources of nutrients, food habits and food preferences. Information regarding food consumption pattern, dietary habits and food preferences of the subjects was collected through the diet survey. To elicit information regarding the dietary pattern of the respondents, questionnaire method was used. Questions were prepared to know about the dietary habits, food preferences and food consumption pattern of the subjects and also questions about eating habits, food fads and fallacies and habits of taking food from outside the home. The questionnaire developed for this purpose is given in Appendix-IV.

The frequency of use of different food items in the dietaries of respondents clearly indicate the adequacy of diet consumed by them. In this study food use frequency and food preference were measured using a check list on an eight point scale and a three point scale respectively. The locally popular foods and those frequently advertised through media were listed and respondent's use and preference for each item was rated separately. The food use frequency and preference score for each of the food groups used by the respondents were calculated using the formula suggested by Reaburn et al., (1979) as follows.

$$\text{Mean score} = \frac{RiSi + Ri\,Si + \ldots RnSn}{100}$$

per cent of total score = Mean Score / n

Si = Scale of rating given for frequency of use of a food item (i=1, 2.,…..n)

Ri = Percentage of subjects selecting a rating coming under each frequency

group (i=1,2…n).

n = Maximum scale of rating (8 in this case).

The percentage of respondents using each food item and also their preference for each food item was then computed based on the frequency of use and food preference score.

3.2.6.2.1 Food Weighment Survey

The actual food intake of the micro sample was determined by food weighment method. Food weighment method was used to assess the quantity and quality of the diet consumed and thus to determine the dietary adequacy of the subjects. Gore et al., (1997) opined that actual food intake assessed through food weighment method gives reasonably accurate values of individual dietary intake.

Weighment survey was conducted for three consecutive days in this study. According to Rao (1975) any single day or two day weighment method would be as efficient a tool as that of seven days.

Conduct of Food Weighment survey

Three-day weighment was done for assessing the actual food intake during normal days excluding festival days and other special occasions. During the food weighment survey, all the raw foods used for family cooking as well as the total cooked food weight of each preparation was recorded. The investigator first weighed the raw foods included in the meals for the whole day and then cooked weight of each preparation using a standardized measuring vessel. The amount of each food consumed and the plate waste was also weighed to get the exact amount of food consumed. The raw equivalent of the food consumed was calculated from the total raw amount of each ingredient (gms), total cooked amount (gms) and individual intake of cooked amount. The dietary adequacy of each subject for a day was then calculated from the average of the food consumed for the three days and then compared with corresponding RDA (ICMR, 2000) values for children and adolescents of matching age.

3.2.6.2.2 Macronutrient intake of the subjects

The carbohydrate, fat and protein intake or the macronutrient composition of the diet directly reflects the total energy intake pattern of an individual. Here in this study, the macronutrient intake assessment was done on the micro sample.

Weighment of raw food

Weighment of cooked food

The composite food analysis method gives accurate data regarding the nutrient intake providing losses in cooking etc. This method involves the actual analysis of a composite sample of cooked foods consumed by the subject. It involves the sampling of each item served during breakfast, lunch, tea, and dinner and analysis for the various nutrients (Kawatra, 1997).

For sampling, the subjects were asked to consume each food of the meal by weight. About 10 per cent by weight of food consumed by the subject was taken as sample. All the items consumed throughout the day were kept in a container in the deep freezer. The foods were collected for three consecutive days. Food samples were mixed and ground to a fine paste in a blender. The ground food sample was dried in the oven and made into powder. This powder was used for assay of macronutrients employing standard laboratory techniques by Kawatra (1997). (Appendix -V). The fat estimation was done using the Soxhlet method, protein estimation was done using Khjeldal method and carbohydate intake was estimated using the difference method. Once the macronutrient intake was estimated, it was then compared with the RDA for macronutrients to find out the nutritional adequacy.

3.2.6.3 Time Utilization pattern of the subjects

Time utilization pattern of the subjects was studied to assess their physical activity and energy expenditure. For studying the time utilization pattern and energy expenditure, each respondent was asked to prepare an activity time log for a regular, exam free school week stating the time spent on each activity from the time one gets up in the morning to the time one goes to bed. The activities were then classified into sedentary, moderate, heavy based on the type of activity. From this, time spent for each type of activity was calculated for the whole day along with the time spent for sleep for determining the difference in activity pattern and sleep hours of overweight and normal weight subjects. The schedule developed for obtaining the time utilization pattern of the subjects is given in Appendix –VI.

3.2.6.4 Determination of Energy Balance

Energy balance is the condition in which energy intake is equal to energy output or energy spent by the body. Obesity represents an imbalance resulting from an excess of energy input from food over energy out put or expenditure.

Body weight is regulated by maintaining a balance between energy intake and energy expenditure. Any factor that causes energy imbalance by increasing energy intake or decreasing energy expenditure can cause obesity in the long run. Hence an in-depth study on energy balance was carried out on the micro sample of 120 children with 72 children drawn from the overweight group and 48 children from the normal weight group.

3.2.6.4.1 Energy Intake

The actual food intakes of the micro sample of 120 subjects were determined from the three day food weighment survey. And from the average daily food intake, the energy intake of the micro sample was computed using food composition table (NIN, 1999). It was further compared with RDA for each age group. Comparison of energy intake was also made between different groups.

3.2.6.4.2 Energy Expenditure

Basal metabolic rate (BMR) and physical activity are the two major factors which determine the energy expenditure of an individual.

The energy expenditure for a week was assessed using the information collected from the activity time log used for assessing the time utilization pattern. The average workload per day was thus computed by finding the number of hours spent for each activity in school and at home along with hours spent for sleep.

Energy expenditure for external activities was thus calculated from the activity time log by grouping the activities as sedentary, moderate, and heavy and sleep. Energy expenditure for sedentary, moderate, heavy and sleep was determined using the following computation formula.

Sedentary activity – 0.02 Kcal X body weight X minutes

Moderate activity- 0.04 Kcal X body weight X minutes

Heavy activity -0.08 Kcal X body weight X minutes

Sleep – 0.01 Kcal X bodyweight X minutes

The basal energy requirement is regularly estimated as the energy need per kg of body weight, which is assumed as one calorie for every hour per kilogram of body weight. Thus the basal energy expenditure for 24 hours for children and adolescents is calculated as 1 x 24 x body weight. However, some energy is saved during sleep and

savings for sleep is calculated as 0.1 x body weight x hours of sleep. This is deducted from the total basal energy expenditure for 24 hours to get the basal energy expenditure of the individual (Swaminathan, 2005).

Thus the total energy expenditure was calculated from the basal metabolic rate, and the type of physical activities engaged in by the children. The energy balance of each subject was thus calculated by finding the difference in the energy intake and energy expenditure of the subjects.

3.2.6.5 Assessment of Overweight related problems

Obesity is associated with a number of problems and co-morbidities. In the present study the health, physical, academic, psychosocial and behavioral problems related to overweight and obesity were determined using appropriate techniques.

3.2.6.5.1 Health and Physical Problems: The general morbidity pattern of each respondent for the previous one year was assessed using a checklist. The checklist was formulated on the basis of review of relevant literature and in consultation with experts in the field. The checklist was given to the subjects and information regarding their health problems was collected. The present health status of each respondent was also assessed by a physician giving special emphasis on health problems associated with overweight and obesity. The blood pressure of the subjects was also taken by auditory method using sphygmomanometer. Physical problems associated with overweight and obesity was rated by the children and their parents using a suitably developed rating scale. (Appendix VII).

3.2.6.5.2 Academic, Psycho-social and behavioral adjustment problems of the subjects in school and home were also measured. As no locally suitable and relevant scale was available for assessing psychosocial problems, a culture appropriate suitable scale was developed based on the scales of Parikh and Das (1988) and Sharma (1972) with necessary modifications and the scale was standardized using standard procedures.

Psychosocial and Behavioral Adjustment Scale (PBSA Scale)

The scale was constructed by selecting relevant statements through review of literature and consultation with experts. Approximately two hundred and fifty statements which will reveal the psychosocial and emotional problems of overweight children were identified and categorized into six groups with equal number of positive and negative

statements with the help of ten subject experts and relevant literature. Self perception of physical attributes, behaviour in family, emotional & behavioural problems, social and academic problems, and problems with values and adjustment were the main topics included in the development of this scale.

These statements were administered to the 100 non-sample overweight and normal weight children between the age groups of 10-15 years from two randomly selected schools. They were asked to respond to each statement in terms of their own agreement or disagreement on a five point continuum. The scores given were 5 -strongly agree, 4 - agree, 3 - doubtful, 2 - disagree, 1 - strongly disagree for positive statements. For negative statements the order was reversed. The total score was the summation of numerical weight assigned to each response.

Item analysis was done following the same procedure described under construction OR-KAP scale (described below). The reliability and validity of the scale was also confirmed in the same way. The reliability coefficient of the psychosocial scale was found to be 0.78 in the split-half reliability test revealing significant reliability and consistency of the scale in measuring psychosocial and other problems in overweight children. Thus the final psychosocial and personality adjustment scale after pre-testing and item analysis consisted of 120 statements in six sections with 20 statements in each section. This five point scale was given scores 1, 2, 3, 4 and 5 with 5 being the maximum scores indicating least problems and 1 being the lowest score indicating most problems. Thus the maximum possible score for the six sections in this scale is 600 and the minimum possible score is 100. The standardized scale thus developed is given in Appendix – VIII.

3.2.6.6 Assessment of knowledge, attitude and practices related to overweight and obesity.

Nutritional cognition is the outcome of nutritional awareness. It is basically the knowledge of nutrients and their role in physiological and biochemical reactions in the body and the attitude and practices followed which determines the food consumption pattern. Along with nutrition cognition, in this study the knowledge, attitude and practices of the subjects towards weight reduction, physical activity, obesity related diseases etc. were also assessed.

Hence a scale termed as Obesity Related KAP (OR-KAP) scale was developed to measure the knowledge, attitude and practices of the subjects on food, nutrition, diet related diseases, weight reduction and physical activity based on relevant literature. The scale consists of three sections namely, K, A and P which measures the knowledge, attitude and practices of the respondents towards food and nutrition, health and diet related diseases and physical activity, weight reduction and weight normalcy. The OR-KAP scale thus developed is given in Appendix- IX.

3.2.6.6.1 Obesity Related Knowledge Scale (OR –K)

Knowledge is a body of understood information possessed by an individual or by culture which is in accordance with established facts (Hendersons et al., 1987). The first section –K of the OR-KAP scale consisted of statements that assess the knowledge of the subjects and it is developed as below.

An item pool of 150 statements relevant to nutrition knowledge on selected areas such as balanced diet, functions of food, nutritive value of food stuffs, nutritional deficiencies, weight reduction and proper cooking methods without nutrient loss were formulated. These statements were prepared from relevant literature and by consultation with experts. Both positive and negative statements were framed. Care was taken to use simple and clear statements with no ambiguity in language or idea to avoid confusion and doubts. A jury consisting of 15 subject experts analysed the statements. In the light of the suggestions made by the experts 130 statements with high scores were selected and were pre-tested on 100 children including overweight and normal weight children selected from 10 -15 year olds. Based on the result of the pretest, and item analysis 60 statements were selected finally.

Item Analysis

Item analysis is an important step towards constructing a valid and reliable scale. The purpose of item analysis is to examine how well each item discriminates between each other. On the basis, items with good discrimination values were selected and others were eliminated. To standardize the scale developed, item analysis was carried out in this study using the method by Singh (2002).

Item analysis yielded two kinds of information that is an index of item difficulty and index of item validity. The selected 130 items were administered to 100 overweight children between the ages of 10-15 years including boys and girls, overweight and normal weight children selected from two randomly selected schools that were not included in the final study. Each item had three answers, right, wrong and doubtful. Every right answer was given a score 2, 'doubtful' response 1 and the wrong response 0. The total score of respondents for each item was thus calculated and arranged in descending order from higher to lower score. The upper 27 per cent and lower 27 per cent were then selected and the middle 46 per cent were eliminated.

From the difference between the upper and lower group, discrimination index (d) was calculated. Items with (d) values greater than 0.30 were selected for the scale.

The next step was to determine the item difficulty index. The index of the item difficulty indicator is the extent to which an item is difficult. An item should not be too easy that all persons can answer it correctly, nor should it be so difficult that none can answer it correctly.

The item difficulty was worked out in the present study by employing the following formula

$$p = \frac{R_U + R_L}{N_U + N_L}$$

Where, R_U = total number of correct responses in the upper 27 per cent

R_L = total number of correct responses in the lower 27 per cent

N_U = number of respondents in the upper 27 per cent

N_L = number of respondents in the lower 27 per cent

The index of difficulty is also corrected for chance of success or guessing using the formula

$$\text{Item difficulty index (pc)} = R - \frac{W}{(K-1)}$$

Where,

R = number of correct answers

W = number of incorrect answers

K = number of response options in the item

N = total number of examinees

HR = number of examinees who did not answer the item

Statements with item difficulty or 'p' values above 0.77 for the three point scale and 'P' values above 0.69 for the five point scale were selected for the scale.

Reliability and Validity

A good test possesses three outstanding qualities-reliability, validity and usability (Ross and Stanley, 1954). The degree, to which the scale yields consistent scores, when the attitude is measured a number of times, is its reliability. Similarly, the degree to which the scale measures what it is purported to measure forms the validity of the scale (Syamakumari, 1993).

Reliability of the scale

In order to test the reliability of the scale, split-half reliability method was used. The test was administered on 100 subjects and their scores for odd and even items of each of the variables in the inventory were obtained. The split-half reliability coefficients were then calculated for the different components of the whole test after correction, using Spearman-Brown Prophecy Formula (Garret, 1969). The reliability coefficient of the knowledge scale was found to be 0.75.

Validity of the scale

The adequacy of sampling of the subject matter of the test is ensured, in the present test by giving due representation to all the factors included in the study. The fact that the test is prepared on the basis of sound theoretical constructs as well as on the basis of similar previous tests is the proof of the validity of the test. The finalized scale after pre-testing and item analysis thus consisted of three sections of 60 statements with 20 statements in each section. The scale is rated on a three point scale of 2, 1 and 0 scores with 2 as the maximum score for each statement. The maximum possible score for the test indicating highest knowledge level is 120 and the minimum possible score indicating lowest knowledge level is 0.

3.2.6.6.2 Construction of Obesity Related Attitude Scale (OR –A)

Attitude is the degree of positive or negative effect associated with some psychological object towards which people can differ in varying degrees. An attitude cannot be directly measured and have to be inferred from the opinion and expression of the individual. It is imperative to have as many clear and simple statements as to provide opportunity to the respondents to reveal the extremes of his or her attitude (Bagchi, 1999). In the present study an attitude scale following the summated rating technique of Likert (1932) was developed to measure the attitude of overweight children towards nutrition, diet related diseases, physical activity and weight reduction.

The second section –A of the OR-KAP scale for measuring attitude and standardized following the same method used for knowledge scale. All possible statements which will discriminate the positive and negative attitudes of overweight children towards Nutrition, Diet, Health, Weight Reduction and Physical activity were collected through a pilot survey, discussion with experts and from review of literature. And a total of 150 statements were thus identified.

These statements were given to 15 experts, to test the relevancy and accuracy of the statements. The responses were collected in a three point continuum of Most Relevant (MR), Relevant (R) and Not Relevant (NR). The scores were given as 2 for MR, 1 for R, 0 for NR respectively. The total score for each statement given by the expert was calculated. The statements were ranked in descending order of their scores. From this 100 statements with highest scores were selected and subjected to item analysis in the same way as done for the knowledge test.

Item Analysis

The selected 100 statements were administered to 100 children of 10-15 years including boys, girls, overweight and normal weight children selected randomly from 2 schools that were not part of the final study. The responses of each item were obtained on a three point continuum from ‘Yes’, ‘Doubtful’ and ‘No’ and every right answer was given a score 2, ‘doubtful’ response 2 and wrong response 1. Item analysis for this three point scale was done in the same way as explained above for the knowledge test and 48 statements were selected finally for the actual survey purposes. Attitude scale thus

developed is standardized after testing the reliability and validity. The reliability coefficient of the test was found to be 0.77. The finalized scale thus consisted of three sections 48 statements with 16 statements in each section. The scale is rated on a three point scale of 3, 2 and 1 scores with 3 as the maximum score for each statement. The maximum score gives the right attitude while lower scores reveals wrong attitude. The maximum possible score for three sections of the attitude scale is 144 and the minimum possible score is 48.

3.2.6.6.3 Obesity Related Practices Scale (OR –P)

A rating scale was prepared based on the nutrition related practices of the families with respect to i) food production / purchase, ii) food preparation and consumption and iii) physical activity and weight reduction. Rating means measuring an attribute of objects or persons by judgment in a continuum (Bagchi, 1999).

Relevant literature was referred to and experts were consulted in order to identify the statements based on the above aspects. Thus 150 statements were identified. These statements were distributed among 15 experts to test the relevancy like the attitude test and 120 statements were then selected based on the scores obtained Item analysis was done in the same method as in the development of OR-K and OR-P scales. Similarly, the same procedure used for assessing the reliability and validity of knowledge and attitude scales was also followed for OR-P scale. The reliability coefficient of the OR – P scale was found to be 0.79. Finally the scale consisted of 39 statements including positive and negative statements. The score given for the positive statement is 3, 2 and 1 with 3 as the maximum score for correct answer, 2 for doubtful and 1 for wrong answer and for negative statements vice versa. Thus the maximum possible total score in this scale is 117 for the correct practices and the minimum possible score is 39 for 13 statements in each of the three sections of the OR-P scale

The OR-KAP test administered to the final sample along with other questionnaires used in this study. The subjects were asked to read each statement carefully and mark ‘yes’ ‘no’ or ‘doubtful’ corresponding to each question. The correct response was given the highest score of 2 for knowledge scale and similarly 3 was given as the highest score for the correct responses in the attitude and practices scale. The scores for each subject were then totaled for each scale and the data was then statistically

analysed. The statistically significant difference in the scores of overweight and normal weight children was computed by employing Analysis of Variance method.

3.2.6.7 Diet Counselling and Health Education

Survey of the relevant literature revealed that social and behavioral interventions along with diet modification and nutrition education can help in the prevention and management of overweight and obesity. The risk of the problems associated with obesity in later life can be prevented by starting the interventions from childhood itself. In the present study diet counselling and health education were given separately to overweight children of the micro sample and their parents and the impact was examined.

Children and families who were keen and motivated to lose weight were selected for counselling and health education. Those who appeared disinterested, apathetic with poor willingness to comply with the dietary restrictions were excluded from the study. The height, weight, BMI and body fat of the subjects were recorded initially along with the assessment of their initial nutritional knowledge and attitude towards physical activity and weight normalcy. Their normal nutrition related practices were also initially observed. Awareness classes were conducted to parents and obese children on childhood obesity and associated problems and how to overcome or manage childhood obesity. Education was also given on the importance of eating a balanced diet, how to make right and healthy food choices based on the Food Guide Pyramid and proper cooking methods for nutrient conservation. The detrimental health effects of fast foods and other energy dense snacks and carbonated beverages, mechanism of energy balance from energy intake and expenditure, how to control energy intake using calorie count and food exchanges and the importance of physical activity for weight reduction/weight maintenance were also the important topics included for health education.

Diet counselling and health education were given to children and families (mostly mothers) with follow up motivation sessions as well as telephone follow-up sessions for a period of six months. The importance of eating a nutrient rich low calorie diet with daily physical activity in weight reduction was emphasized during counselling. Children were advised to avoid or limit calorie dense fast foods, snacks, bakery items, fried items, carbonated beverages and sweetened juices. Since overweight children were noticed to be eating a greater quantity of meat items like beef and chicken they were also made

Diet Counselling Session

aware of the importance of controlling portion sizes during the meal. Parents and children were also informed about the approximate caloric content of commonly used food items and they were also made educated on how to do a calorie count of the daily food intake for effectively managing the calorie intake each day. They were advised to replace junk foods with plenty of vegetables and fruits. Mothers were given information on effective cooking methods for weight reduction and advised to avoid the use of hydrogenated fats and animal fats for cooking purposes. Children were also encouraged to go to school /tuition classes either by walking or cycling if possible.

Leaflets and booklets on obesity management were also given to each family along with sample diet/ menu pattern for weight reduction. Children were motivated to follow the planned diet with the help of their parents. The subjects were closely monitored and impact was assessed after 6 months by recording their change in height, weight, BMI and body fat. Along with this, the change in nutritional knowledge scores and attitude towards physical activity and weight normalcy were also assessed. The change in nutrition related practices after six months was also observed. The leaflet and booklet for obesity management with sample weight reduction diets developed for distribution to the subjects after diet counselling are given in Appendix –X.

3.3 Statistical Analysis

The data collected through different tools were scored, coded, consolidated and subjected to appropriate statistical analysis and interpretations. The statistical analysis that was done on the data includes:

Mean, Frequency, Percentages and Chi square: For the analysis of socio-demographic features

Tests of significance:-

Z –test: To find out the significant difference in the prevalence of overweight and obesity in rural and urban children

Chi square: To find out the significance in age wise relationship of overweight and obesity prevalence in rural and urban children

Analysis of Variance: To find out the difference in anthropometric measurements, activity pattern, knowledge, attitude and practices, psychosocial and

behavioral adjustment problems in overweight and normal weight children.

t-test : Two sample t-test was done to find out the difference in the energy intake, energy expenditure, energy balance and macronutrient intake of the micro sample. Paired t-test was done to find out the difference in anthropometric measurements before and after diet counselling and health education.

Correlation: To identify the characters that has maximum correlation with the development of overweight and obesity.

4. RESULTS

The results of the study entitled "Contributing factors and problems associated with - overweight among rural and urban school children" are illustrated in this chapter under different sections. The major objectives of the study was to identify the obesogenic environmental factors and familial characteristics contributing to overweight and obesity and also to find out the health, physical academic and psychosocial problems associated with overweight and obesity. Keeping in view of the objectives of the study, data collected from the macro and micro sample were statistically analysed and the results are presented below.

4.0 Prevalence of overweight and obesity among rural and urban school children in the Thiruvananthapuram educational District.

4.1 Comparison of anthropometric measurements between overweight/obese and normal weight children in rural and urban areas

4.2 Obesogenic Environmental Factors and Familial characteristics of the subjects

4.3 Dietary Profile and Food Consumption Pattern of the subjects

4.4 Time utilization and activity pattern of the subjects

4.5 Energy balance from energy intake and energy expenditure of the subjects

4.6 Overweight related problems of the subjects

4.7 Nutritional knowledge, attitude and practices of the subjects

4.8 Diet counselling and Impact of health education

4.9 Interrelationship between variables selected for the study

4.0 Prevalence of overweight and obesity among school children in rural and urban areas of Thiruvanathapuram District

A total of 3886 children were screened from rural and urban schools to get the study sample of 720 overweight children and 120 normal weight children from 10-15 years of age. When the BMI of the children were compared, the following results were obtained which are presented in Tables 1, 2, 3 and 4.

Table 1 gives the age wise distribution of the total number of children screened and it was grouped into five groups namely obesity, overweight, normal weight, underweight and severe underweight based on their BMI.

As could be seen in Table 1, from the overall screened sample of 3886, 4.99 per cent were obese, 17.73 per cent were overweight, 58.67 per cent were normal weight, 16.16 per cent were underweight with a BMI less than 15, while 2.44 per cent were of severe underweight with BMI less than 13. The results revealed that when about 22.72 per cent of the children were above normal weight and 18.60 per cent were below normal weight and 58.67 per cent were of normal weight. This revealed that the prevalence of overweight and obese children were higher than underweight and severe underweight children. The study thus exposed the fact that undernourished and severely undernourished children are still prevailing in the state just as over nourished children. Though the percentage of normal weight children was found to be higher than the other groups, they formed only half of the total i.e 58.67 percent.

When the sex wise comparison of all the boys and girls were made (Table 1), it was noted that out of a total of 3886 children screened, 1769 were girls, and 2117 were boys. Among the 1769 girls, 16.39 percent were overweight and 3.79 percent were obese. Similarly among 2117 boys 18.80 percent were overweight and 5.99 percent were obese.

It can also be noted from the data that obesity and overweight were seen more in boys whereas underweight and severe underweight seemed to be more in girls indicating an increasing trend in the percentage of overweight in boys compared to girls.

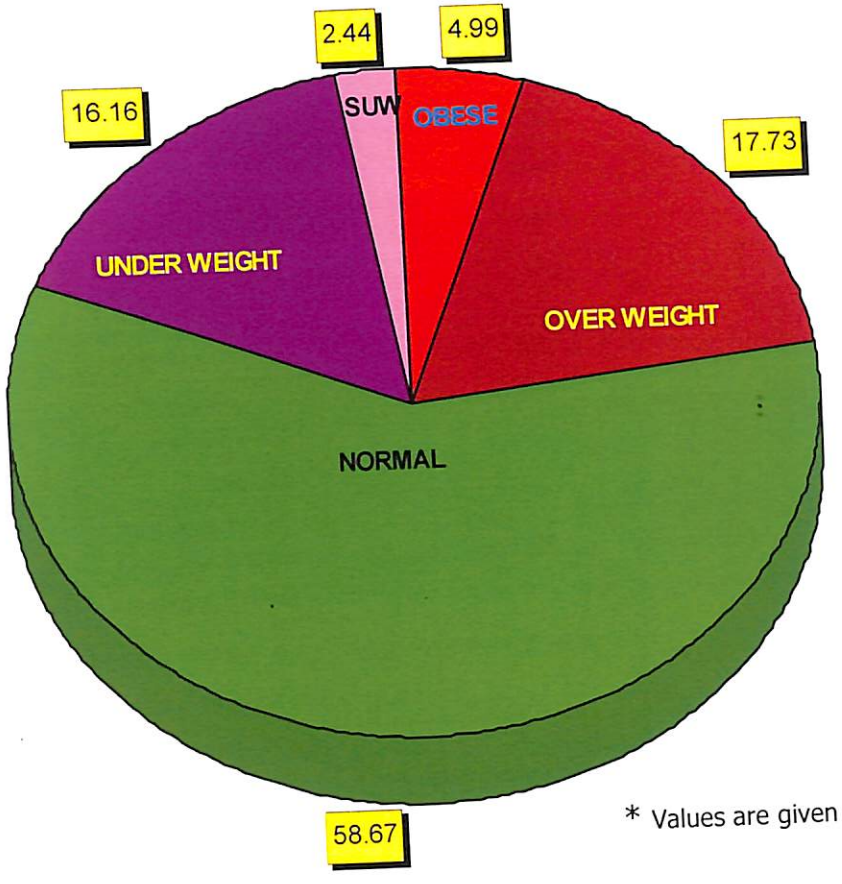
When area wise comparison of weight status of boys were made, amid 409 rural boys and 1708 urban boys 8.31 percent were overweight in rural areas, and 21.31 percent were overweight in urban areas. Obesity prevalence was noted to be 2.93 percent among rural boys and 6.73 percent in urban boys. When girls alone were considered, it was noted that out of a total of 889 rural girls and 880 urban girls the overweight prevalence was 11.92 and 20.90 percent respectively. And the obesity was found to be 2.25 percent in rural girls and 5.34 percent in urban girls.

Table 1. Comparison of overweight and obesity in rural and urban school children in Thiruvananthapuram educational district

Group	Age	No	Obese		Overweight		Normal		Underweight		Severe underweight	
			No	%	No	%	No	%	No	%	No	%
Rural Girls	10	170	1	0.58	9	5.39	89	52.35	55	32.30	15	8.30
	11	172	2	1.16	15	8.70	87	50.50	56	32.39	12	6.97
	12	159	9	5.66	22	13.83	80	50.30	43	27.04	5	3.14
	13	194	6	3.09	30	15.46	131	67.50	23	11.85	4	2.06
	14	115	2	1.74	15	13.04	87	75.60	9	7.80	2	1.74
	15	79	0	0.00	15	18.99	58	73.40	6	7.59	1	1.27
Total		889	20	2.25	106	11.92	532	59.84	192	21.60	39	4.39
Urban Girls	10	198	11	5.5	34	17.2	101	51	44	22	7	3.5
	11	194	11	5.7	38	19.58	109	56	31	15.97	5	2.57
	12	171	8	4.67	33	9.3	110	64.3	17	9.94	3	1.75
	13	154	10	6.5	49	31.8	83	53.89	12	7.79	0	0
	14	144	6	4.2	26	18.05	107	74	4	2.77	1	0.69
	15	19	1	5.26	4	21	14	73.7	0	0	0	0
Total		880	47	5.34	184	20.9	524	59.55	108	12.27	16	1.81
Girls Total		1769	67	3.79	290	16.39	1056	59.69	300	16.96	55	3.11
Rural Boys	10	45	1	2.22	5	11.11	16	35.50	20	44.00	3	6.60
	11	60	2	3.33	5	8.30	29	48.30	17	28.30	7	11.66
	12	68	2	2.94	6	8.82	43	63.23	15	22.05	2	2.94
	13	73	3	4.11	7	9.59	43	58.90	19	26.02	1	1.37
	14	85	1	1.18	7	8.24	67	78.80	10	11.76	0	0.00
	15	78	3	3.84	4	5.12	62	79.49	8	10.26	1	1.28
Total		409	12	2.93	34	8.31	260	63.57	89	21.76	14	3.42
Urban Boys	10	357	26	7.30	73	20.4	164	45.9	84	23.5	11	3
	11	384	28	7.30	85	22	192	50	67	17.45	12	3.1
	12	295	22	7.45	61	20.68	170	57.6	40	13.56	2	0.678
	13	303	19	6.27	71	23.4	190	62.7	23	7.59	0	0
	14	284	19	6.69	58	20.4	185	65	20	7.04	1	0.35
	15	85	1	1.17	16	18.82	63	74	5	5.88	0	0
Total		1708	115	6.73	364	21.31	964	56.44	239	13.99	26	1.52
Boys Total		2117	127	5.99	398	18.80	1224	57.82	328	15.49	40	1.89
Grand Total		3886	194	4.99	689	17.73	2280	58.67	628	16.16	95	2.44

As revealed in the table, the results of the area wise comparison of the weight status of boys and girls indicated that in rural area the rate of underweight and severe underweight were higher compared to overweight and obesity respectively. However, in urban areas obesity and overweight predominated with higher prevalence than underweight and severe underweight in both boys and girls. Even though the rate of severe underweight is low; its prevalence was more than double in rural areas compared to urban areas.

CLASSSIFICATION OF 10-15 YEAR OLD CHILDREN BASED ON BODY MASS INDEX (IOTF) CUT OFF VALUES



* Values are given in percentages (%)

In order to see the variation based on age of the children, age wise comparison of boys and girls from both rural and urban areas were made. And it was found that 12 year old rural girls' and13 year old urban girls had the highest rate of obesity. Similarly for overweight, 15 year old girls have the highest predominance in both rural and urban areas. Like wise in the case of boys, 13 year old rural boys have the highest obesity, and among urban boys 12 year old have the highest obesity prevalence. When the prevalence of overweight is compared, it was highest in 13 year old boys in both rural and urban areas.

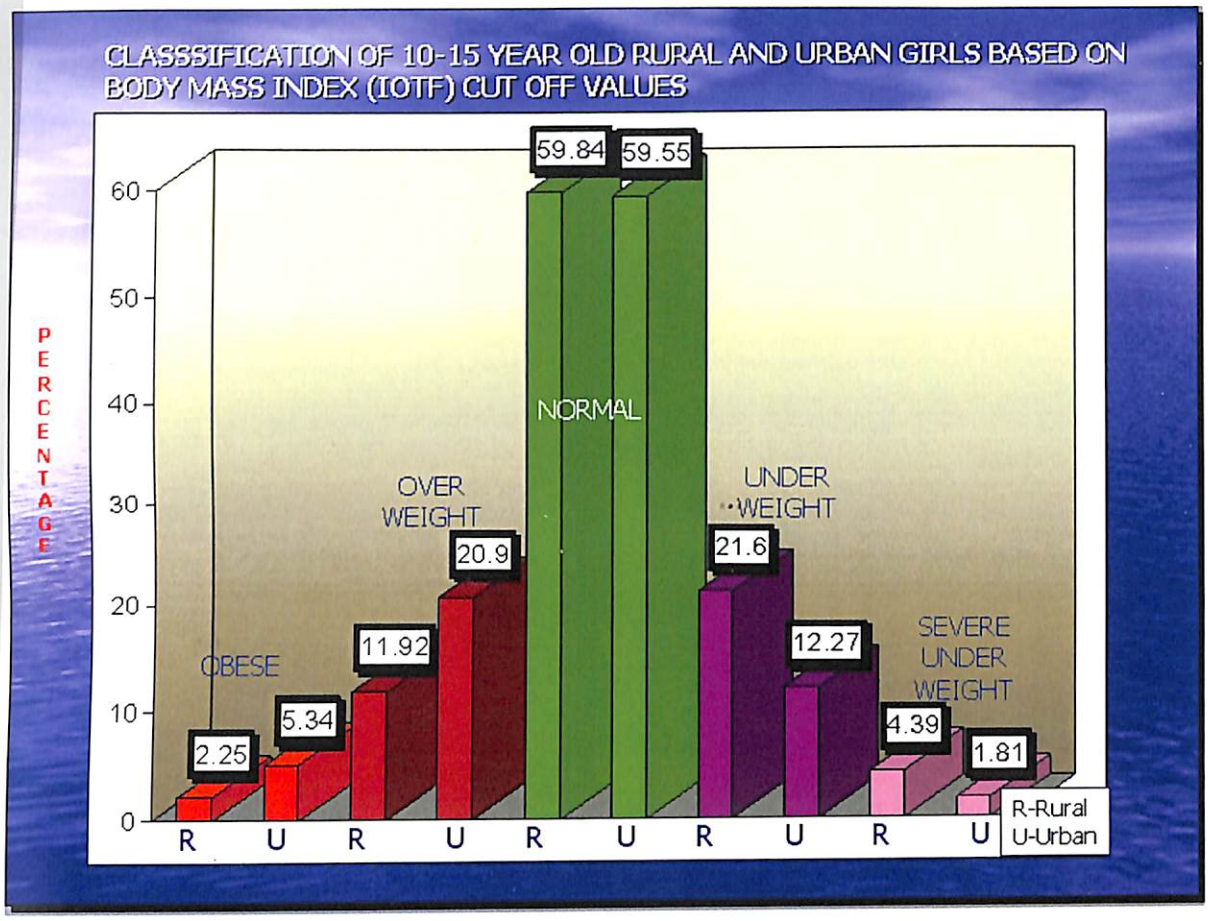
It could also be seen that overweight and obesity was comparatively higher in urban boys and girls than rural boys and girls. Another interesting finding was that obesity is lowest in 15 year old girls in the rural area and 14 year old girls in the urban areas. Among boys, 15 year old urban boys and 14 year rural boys have. the lowest obesity. However, overweight in girls is more in 15 years

It is also interesting to note that among rural girls obesity seems to increase from 10 years (0.58 per cent) and reached the peak at 12 years (5.66 per cent) and then gradually started decreasing as age advances and was lowest at 15 years with zero per cent prevalence.

Comparison of Prevalence of overweight and obesity in Rural and Urban Areas

Area wise comparison of overweight and obesity prevalence was also carried out in the screened children. When boys and girls of rural and urban areas were compared, it was found that there was difference in the prevalence of overweight and obesity in both boys and girls from rural and urban areas. In order to see whether this difference in prevalence was statistically significant, statistical analysis (Z- test) was carried out and the results are presented in Table 2.

The prevalence of overweight is found to be statistically different (Z = 15.3**) between rural boys (8.31 %) and urban boys (21.31%) of 10-15 years of age group. Also, it was noted that a statistically significant difference (Z = 10.23**) existed in the prevalence of overweight among rural girls (11.92 %) and urban girls (20.9%) of the same age group.


CLASSSIFICATION OF 10-15 YEAR OLD RURAL AND URBAN GIRLS BASED ON BODY MASS INDEX (IOTF) CUT OFF VALUES
PERCENTAGE
60
50
40
30
20
10
0
OBESE
OVER WEIGHT
NORMAL
UNDER WEIGHT
SEVERE UNDER WEIGHT
2.25
5.34
11.92
20.9
59.84
59.55
21.6
12.27
4.39
1.81
R U R U R U R U R U
R-Rural
U-Urban

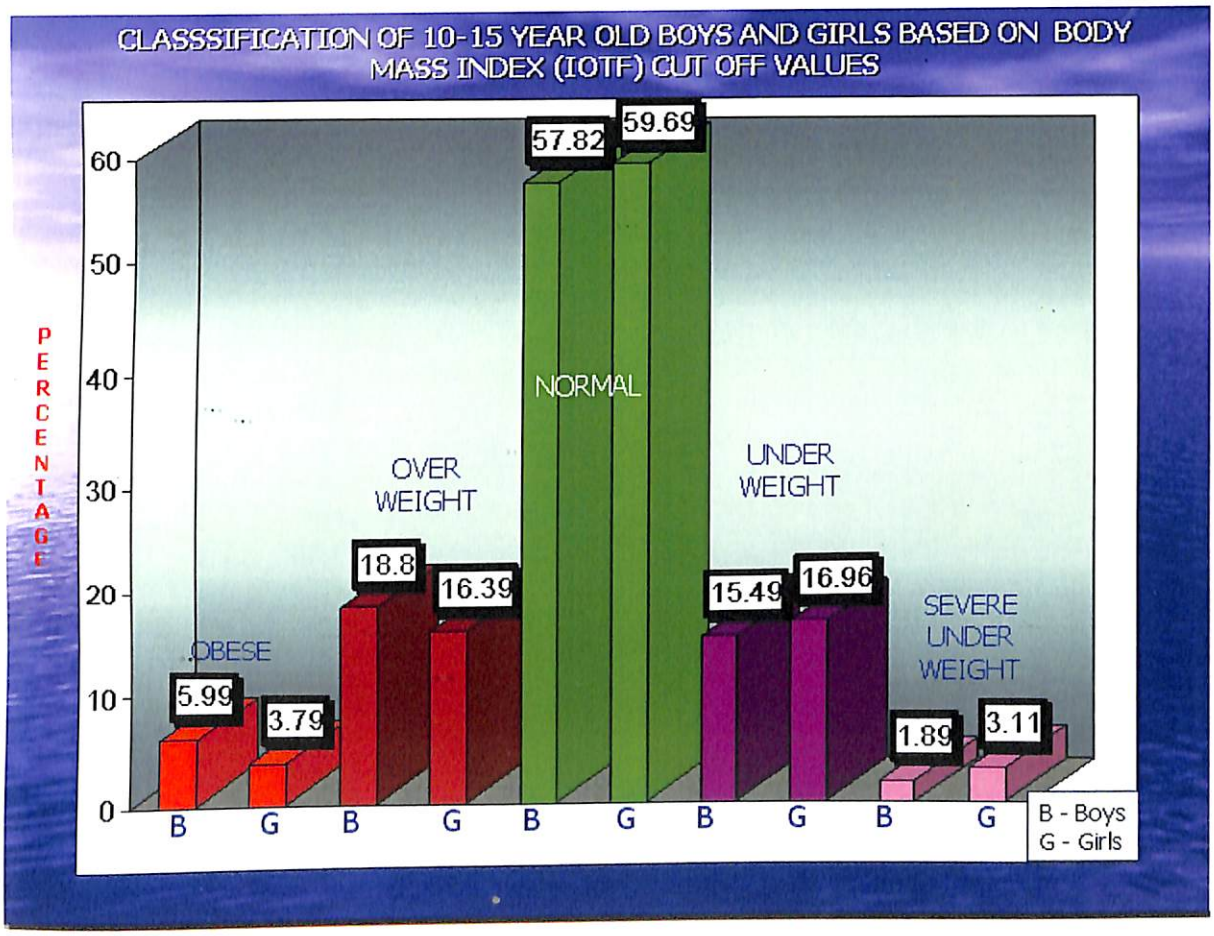

CLASSSIFICATION OF 10-15 YEAR OLD BOYS AND GIRLS BASED ON BODY MASS INDEX (IOTF) CUT OFF VALUES
PERCENTAGE
60
50
40
30
20
10
0
OBESE
OVER WEIGHT
NORMAL
UNDER WEIGHT
SEVERE UNDER WEIGHT
5.99
3.79
18.8
16.39
57.82
59.69
15.49
16.96
1.89
3.11
B G B G B G B G B G
B - Boys
G - Girls

Table 2. Comparison of overweight and obesity between rural and urban children.

Groups	Percentage Prevalence		Z-test	
	Overweight	Obesity	Overweight	Obesity
Rural Girls	11.92	2.25	10.23**	6.94**
Urban Girls	20.90	6.94		
Rural Boys	8.31	2.93	15.3**	7.36**
Urban Boys	21.31	6.73		

The prevalence of obesity in urban boys (6.73%) of 10-15 years of age group is noted to have a highly significant difference (Z = 7.36**) compared to that of rural boys (2.93%) in the same age group. Similarly there existed a highly significant difference (Z = 6.94**) in obesity between urban girls (5.34 %) and rural girls (2.25%) of similar age groups. Overweight and obesity was observed to be more in children from urban areas than rural areas.

4.1 Age wise distribution of anthropometric measurements of overweight and normal weight children of rural and urban areas.

From the total children screened from different schools, 720 overweight children and 120 normal weight children were selected for the study. Besides the anthropometric measurements like height, weight and BMI, the body fat, waist circumference, waist:hip ratio and mid upper arm circumference of the sample was also taken. The age wise and the area wise distributions of the anthropometric measurements are presented in Table 3 and Table 4.

The anthropometric measurements of overweight and normal weight children were different with overweight children having higher values not only for weight, BMI and body fat, but also in waist circumferences, waist hip ratio and mid arm circumferences.

Table 3. Age wise distribution of anthropometric measurements of the overweight and normal weight girls of rural and urban areas.

Rural Girls	Age	Group	Height (cm)	Weight (kg)	BMI* (kg/m2)	Body Fat (%)	WC (cm)	WHR (wc/hc)	MUAC (cm)
	10	Overweight	135.93	40.10	21.65	29.84	78.93	0.89	25.00
		Normal weight	133.70	32.50	18.08	25.00	70.80	0.83	22.80
	11	Overweight	142.68	48.23	23.59	27.99	81.33	92.17	25.26
		Normal weight	145.18	39.50	18.72	24.32	78.40	91.20	24.80
	12	Overweight	149.27	53.60	24.00	28.39	81.80	0.87	26.23
		Normal weight	154.52	47.00	19.59	24.10	80.40	0.85	24.90
	13	Overweight	154.65	59.00	24.64	30.68	85.10	0.87	26.70
		Normal weight	149.24	45.00	20.11	23.10	80.00	0.84	23.10
	14	Overweight	157.65	60.90	24.46	31.01	89.10	0.88	29.23
		Normal weight	155.30	48.70	20.16	24.28	83.00	0.85	26.60
	15	Overweight	156.09	62.45	25.60	32.37	88.77	0.88	27.10
		Normal weight	155.36	49.10	20.20	25.20	83.00	0.86	27.00
UrbanGirls	10	Overweight	138.51	43.20	22.38	29.45	79.13	0.89	24.90
		Normal weight	137.46	34.60	18.24	23.32	73.00	0.84	22.00
	11	Overweight	146.21	51.08	23.78	31.96	80.63	0.88	25.27
		Normal weight	140.82	36.30	18.23	23.62	73.60	0.85	24.20
	12	Overweight	150.40	53.87	23.70	33.07	81.50	0.87	26.33
		Normal weight	145.90	40.70	19.13	23.72	81.00	0.86	24.80
	13	Overweight	155.14	59.10	24.54	33.04	86.16	0.87	26.40
		Normal weight	157.86	49.20	19.74	25.38	84.20	0.86	25.20
	14	Overweight	155.49	62.40	25.77	33.63	88.87	0.88	27.20
		Normal weight	152.22	45.80	19.71	24.90	83.60	0.86	26.00
	15	Overweight	156.29	67.68	27.72	35.79	89.63	0.88	27.07
		Normal weight	155.36	49.30	20.36	26.48	86.00	0.86	26.80

- Overweight classification based on IOTF BMI cutoff values (Appendix –I)

Table 4. Age wise distribution of anthropometric measurements of the overweight and normal weight boys of rural and urban areas

Rural Boys	Age	Group	Height (cm)	Weight (kg)	BMI* (kg/m2)	Body Fat (%)	WC (cm)	WHR (wc/hc)	MUAC (cm)
	10	Overweight	143.94	48.25	23.18	25.36	82.00	0.91	25.37
		Normal weight	141.54	36.80	18.39	18.66	68.40	0.84	22.80
	11	Overweight	146.77	51.68	23.89	25.49	83.25	0.90	24.97
		Normal weight	144.46	39.40	18.83	20.92	70.00	0.85	22.60
	12	Overweight	151.05	56.30	24.44	23.78	84.50	0.89	25.37
		Normal weight	150.38	42.60	18.80	20.12	84.80	0.85	25.80
	13	Overweight	156.61	62.88	25.56	24.02	87.73	0.90	28.63
		Normal weight	154.10	48.00	20.12	20.34	86.60	0.85	25.40
	14	Overweight	162.57	68.62	25.84	25.85	92.32	0.90	27.03
		Normal weight	166.30	56.30	20.35	20.16	78.60	0.86	26.00
	15	Overweight	170.42	80.87	27.86	26.04	97.73	0.90	30.20
		Normal weight	165.96	53.30	19.31	19.08	82.80	0.87	27.20
UrbanBoys	10	Overweight	143.08	48.30	23.51	26.26	81.50	0.91	25.13
		Normal weight	146.64	39.80	18.49	17.40	68.20	0.84	22.00
	11	Overweight	146.77	52.38	24.24	23.89	85.67	0.93	25.17
		Normal weight	146.84	38.30	17.76	16.86	70.00	0.85	24.80
	12	Overweight	151.94	59.25	25.39	26.61	86.07	0.91	26.10
		Normal weight	148.46	42.80	18.80	17.76	72.20	0.85	25.40
	13	Overweight	156.19	61.47	25.09	26.26	87.77	0.89	26.27
		Normal weight	157.22	48.60	19.64	18.00	73.80	0.85	25.20
	14	Overweight	161.83	66.16	25.34	24.01	93.03	0.91	26.40
		Normal weight	160.18	50.60	19.68	18.20	78.20	0.86	26.00
	15	Overweight	170.47	81.92	28.18	26.91	109.22	0.90	28.60
		Normal weight	167.36	59.30	21.15	17.20	95.00	0.87	28.00

* Overweight classification based on IOTF BMI cutoff values (Appendix –I)

4.2 Comparison of anthropometric measurements of overweight and normal weight school children in rural and urban areas

As could be seen from Table 3 and 4, the anthropometric measurements like height, weight, BMI, body fat, waist circumference, waist:hip ratio and mid upper arm circumference varied between overweight and normal weight children. In order to see whether the difference is statistically significant, Analysis of Variance (ANOVA) was carried out. The details are presented in Table 5.

An overall analysis of the anthropometric measurements indicated that there existed a highly significant difference in weight, Body Mass Index (BMI), waist circumference, waist hip ratio and mid arm circumference of overweight and normal weight children in rural and urban areas. It can be observed from Table 5 that the highest statistical difference is for BMI and body fat percentage among these groups. As expected, there was no significant difference between the height of overweight and normal children.

Table 5. Comparison of anthropometric measurements between overweight and normal weight boys and girls in rural and urban areas.

	Height	Weight	BMI	Bodyfat	WC	WHR	MUAC
Rural Girls							
Overweight	149.38	53.99	23.97	30.05	84.17	0.880	26.42
Normal	148.89	43.63	19.48	24.33	79.27	0.849	24.73
F value	NS	29.77**	132.92**	88.49**	14.11**	19.85**	6.19**
Rural Boys							
Overweight	155.23	61.43	25.12	25.13	87.24	0.902	25.97
Normal	153.79	46.07	19.31	19.88	75.30	0.858	24.97
F value	NS	31.22**	93.36**	67.49**	44.71**	29.55**	7.38**
Urban Girls							
Overweight	150.34	56.23	24.65	32.82	84.32	0.877	26.11
Normal	148.27	42.65	19.24	24.57	80.23	0.861	24.97
F value	NS	47.09**	130.61**	185.00**	9.83**	5.85**	9.53**
Urban Boys							
Overweight	155.05	61.29	25.29	25.66	88.73	0.919	26.06
Normal	154.45	46.57	19.35	17.57	75.90	0.866	25.23
F value	NS	27.25**	102.58**	157.07**	71.63	37.88**	4.7**

NS – Not Significant, * Significant at 5 percent level, ** Significant at 1 percent level

Since BMI and body fat percentage showed a highly significant difference compared to the other anthropometric measurements, an area wise and age wise comparison was further done to ascertain difference in these aspects. The results of the analysis are depicted in Table 6 and Table 7.

Table 6. Area wise and age wise comparison of BMI (kg/m2) of overweight girls and boys

Age	Overweight Girls			Overweight Boys		
	Rural	Urban	Total	Rural	Urban	Total
10	21.65	22.38	22.01	23.18	23.51	23.34
11	23.59	23.78	23.68	23.89	24.24	24.06
12	24.00	23.70	23.85	24.44	25.39	24.91
13	24.64	24.54	24.59	25.56	25.09	25.32
14	24.46	25.77	25.11	25.84	25.34	25.59
15	25.60	27.72	26.59	27.86	28.18	28.02
Total	23.97	24.65		25.13	25.29	
Comparison:	F	CD		F		CD
Rural Vs Urban:	43.18**	1.3		27.97**		1.77
Between ages :	12.63**	2.05		4.60**		2.79
Age Vs. Place:	4.30*	0.916		NS		

CD: Critical difference at 5 per cent level

Table 7. Area wise and age wise comparison of body fat (%) of overweight girls and boys

Age	Overweight Girls			Overweight Boys		
	Rural	Urban	Total	Rural	Urban	Total
10	29.84	29.45	29.64	25.36	26.26	25.81
11	27.99	31.96	29.97	25.49	23.89	24.69
12	28.39	33.07	30.73	23.78	26.61	25.19
13	30.68	33.04	31.86	24.02	26.26	25.14
14	31.01	33.63	32.32	25.85	24.01	24.93
15	32.37	35.79	34.08	26.04	26.91	26.47
Total	30.05	32.82		25.09	25.65	
Comparison:	F	CD		F		CD
Rural Vs Urban:	25.09**	1.61		21.12**		2.06
Between ages :	10.29**	2.55		9.21**		3.26
Age Vs. Place:	2.25*	1.14		4.19*		1.46

CD: Critical difference at 5 per cent level

Table 6 revealed that there was a statistically significant difference in the BMI between 10 to 15 years of age in both rural and urban boys and girls. Similarly,

difference in BMI of rural and urban boys and girls were also highly significant at 1 percent level. However when the difference in BMI due to the influence of age and place (area) was noted, it was found to be significant with an F value of 4.30** at 1 percent level for girls, where as this difference was observed to be insignificant among boys.

An area wise and age wise comparison of body fat presented in Table 7 revealed statistically significant difference at 1 percent level in boys as well as in girls. Similarly, the influence of age and place/area on body fat was significantly different in girls and boys at 5 percent level and 1 percent level respectively.

4.2 Obesogenic Environmental Factors and Familial Characteristics

The demographic profile, familial and socioeconomic background, home environment, health and behavioural profile of the children were collected through personal interview from parents and children using suitably developed and structured questionnaires. The results of the data collected were analysed in relation to different variables and are presented below.

4.2.1 Demograhic Profile

Religion: The religion and caste wise distribution of the sample is given in Table 8. As indicated in Table 8, majority of the overweight as well as normal weight control sample in urban areas were Hindus. However in rural areas, the percentage of Muslim children was higher since Muslim schools were also part of the study. It can also be noted that the percentage of Christians' subjects were comparatively lower compared to Hindus and Muslims in rural areas than urban areas. But when overweight and normal weight children were compared, not much religion wise difference was noted. Another interesting result observed was that when only 13.89 per cent of urban Muslim boys were overweight, 36.11 percent of the rural boys were overweight. Higher percentages of Hindus and Christian boys were overweight in the urban area, whereas in the rural area Hindu and Muslim overweight children were higher.

In the case of girls also the percentage of overweight was seen more among Hindus and Christians in urban areas than Muslims. In the case of rural girls, the percentage of overweight is more in Hindus and Muslims and less in the case Christians. Statistical analysis using chi square revealed no significant association between religion and overweight.

Caste: Although a religion wise difference was noted among the selected subjects, caste wise distribution of overweight and normal weight children appeared to be consistent. As can be seen from Table 8, majority of the overweight subjects in urban areas belonged to forward caste, whereas majority of the overweight subjects in rural area belonged to backward caste. In the case of both boys and girls, the percentage distribution of overweight was the lowest among Scheduled Castes irrespective of sex or area wise difference. Among Scheduled Caste children, when the percentage of overweight was comparatively high in boys, it was more or less same in girls. And there was no Scheduled Tribes representation in either rural or urban sample. Statistical analysis using chi square revealed no significant association between caste and overweight.

4.2.2 Familial Characteristics

The family structure, composition, education and employment characteristics of the parents of the subjects were included under familial characteristics.

Family Type: Family type was classified into nuclear, joint and extended based on composition. In the present study as depicted in Table 8, more than 80 percent of the urban children and more than 60 percent of the rural children belonged to nuclear families irrespective of their weight status. It can also be noted that none of the subjects in the present study belonged to extended families. Statistical analysis using chi square revealed no association between family type and overweight/obesity in any groups except for rural boys and urban girls where the difference was significant at 1 per cent level.

Family Size: The family size were classified depending upon the number of members as small (1-4 members), medium (5-6 members) and large (>6 members). As shown in Table 8, more than 70 per cent of the urban subjects and more than 60 per cent of the rural subjects belonged to small families. The percentage of subjects who belonged to medium size families among different groups was noted to be less than 23.89 per cent whereas that of large families was still lower in both rural and urban boys and girls. This result was consistent in both overweight and normal weight children of rural and urban areas. But an interesting observation was that when not much difference was seen in the percentage of normal and overweight children from small and medium families, a difference could be seen in large families. The results indicated that more normal weight

children belonged to large families than overweight children. Statistical analysis using chi square revealed a significant relationship between family size and overweight in urban children.

Incidence of Overweight/Obesity in the Family: It was interesting to note from Table 10 that a striking difference existed between overweight and normal weight children when the history of overweight and obesity in their families were studied. Among the different groups studied, the percentage of familial overweight/obesity was more than 75 per cent in all the overweight groups compared to that of normal weight group irrespective of the area wise and sex wise variation. As can be observed from Table 10, statistical analysis of the data (chi square) also revealed a significant association at 1 per cent level between overweight in children and family history of overweight/ obesity.

Sibling Constellation

Data regarding the number of siblings and ordinal position of the subjects are given in Table 9.

i) Number of siblings: As noted in Table 9, majority of the overweight and normal children in both rural and urban areas had only one sibling. It is also interesting to note that normal weight children had more number of siblings compared to overweight children. The results suggested that overweight was seen in majority of the children from single child families and also that there was a decreasing trend in overweight children as the number of siblings increased. Statistical analysis using chi square revealed a significant association at 1 per cent level between numbers of siblings and overweight in rural as well as urban children.

ii) Ordinal Position: When ordinal position of the subjects were analysed, it was found that majority of the overweight children were either first born or last born. Table 9 also clearly depicts that majority of the normal weight children were middle born. Statistical analysis using chi square revealed a significant association at 1 per cent level between ordinal position and overweight in all the children irrespective of regional difference.

4.2.3 Personal Characteristics

Birth History

Information regarding the birth weight of selected subjects, pregnancy term of mothers, breast feeding duration and history of obesity in family were identified and presented in Table 8.

i) Birth weight: It was observed from Table 10 that contradictory to the normal belief, the percentage of the overweight children being born with low birth weight was higher than that of the normal weight children irrespective of the locality and it was vice versa in normal weight children. However, statistical analysis showed no significant association between birth weight and overweight.

ii) Pregnancy: As shown in Table 10, the percentage of preterm overweight children was noted to be higher compared to that of normal weight children in both rural and urban areas indicating more number premature overweight children compared to normal weight children. Statistical analysis showed no significant association between pregnancy term of mothers and overweight / obesity in children.

iii) Breast Feeding: Irrespective of the area and the current weight status, majority of the overweight and normal weight children were breast fed for more than one year. The percentage of children who were not breast fed due to various reasons also remained consistent between the groups. But statistical analysis showed no significant association between breast feeding duration and overweight in children.

iv) Age: Since age was a criterion in the selection of subjects in this study, equal number of boys and girls in each age group from 10 to 15 years from rural and urban areas were included. Thus 50 per cent of the subjects were boys and 50 per cent were girls from each age group.

4.2.4 Socio-Economic Profile

The main variables included to assess the socio-economic profile of the subjects were the education and employment status of the parents, monthly income and expenditure pattern of the families of the subjects.

Educational status of parents: The parental education level of the subjects ranged from below SSLC to professional degree. Fathers with below SSLC education was between zero per cent to 0.55 per cent in different groups of urban children whereas in

rural children it varied from 1.11 per cent to 3.33 per cent It can also be seen from Table 11 that majority of the fathers had a professional degree among all the groups in both rural and urban areas. The percentage of fathers with below SSLC, SSLC and pre degree were lower in all the groups except that of rural girls. The results thus indicated fathers with very low education were very few and were comparatively more in rural areas than urban areas.

The percentage of mothers having bachelor's degree education was higher in both overweight and normal children of urban areas compared to rural groups. In the case of mothers in rural areas majority had only pre degree education. The percentage of mothers holding predegree, bachelors degree, and professional degree were higher than below SSLC, SSLC and Masters degrees. As in the case of fathers, mothers with education below SSLC level education were very few in all the groups studied. Another observation was that more number of overweight boys from rural and urban areas has mothers with professional degree than that of overweight girls.

Employment Status of parents: Employment status of the parents was also studied. As illustrated in Table 12, the percentage of unemployed fathers was very low with an average of less than 1 percent in all the groups. It was also noted that majority of the fathers of rural overweight children were working abroad compared to their normal weight counterparts whereas, the majority of the urban normal weight children's fathers were government employees or self employed and that of urban overweight children were either working abroad or private employees.

It can also be observed from Table 12 that majority of mothers in rural areas and the mothers of normal weight children in urban areas were house wives. The number of working mothers of overweight urban children was comparatively higher compared to all other groups.

According to Kunwar et al. (1998) socio economic status of the family is an important determinant of the health status of children. Hence it was inevitable to consider this aspect in the current study.

Monthly Income: **T**he monthly income levels of the families studied were divided into different groups for clearer perception. Based on the monthly income of the family, they

were classified into low income (< Rs. 2250), lower middle (Rs.2251- 5000), middle income (Rs. 5000- 20,000), upper middle (20,000-50,000), high income (> Rs. 50,000).

Table 13 clearly depicted that majority of the overweight children belonged to middle income and upper middle income. On the contrary, majority of the normal weight children belonged to lower middle income and middle income. The percentage of the children from high income families were also higher in overweight group compared to their normal weight group irrespective of the area. Another observation is that the overweight and income is directly proportional to each other. That is, when the income increases, the rate of overweight also increases.

None of the families of overweight children were in the low income group while up to 6.67 per cent of normal weight children were from low income families among different groups. When Chi square analysis of he monthly family income of the overweight and normal weight children were done, a significant association was found between the weight status and monthly family income in both rural (5.47*) and urban (12.01**) children.

Monthly Expenditure Pattern: Along with the income status, the monthly expenditure pattern especially on food, clothing, education, housing, traveling, entertainment, health care, savings and other items were also assessed and the details are presented in Table 14.

It was clear from Table 14 that the expenditure in families of overweight children on food was higher than that of normal weight children. None of the normal weight children had monthly family expenditure of more than Rs. 3000 on food while families of overweight children were spending more than Rs. 3000 on food. Another major expenditure was on education and it was found to be relatively same in all the groups. Spending for entertainment was found to be comparatively low in all the groups. Majority of the subjects spent only < Rs.500 monthly for healthcare needs. Travel expense and clothing expenses were also lower in all the groups while the savings percentages were found to be higher (between Rs.500-3000) in most of the groups.

Socioeconomic and Demographic Profile

Table 8. Area wise and sex wise distribution of overweight and normal weight children based on demographic profile and familial details

	Urban Boys		Rural Boys		Urban Girls		Rural Girls	
Variables	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
Religion								
Hindu	99 (55.00)	13 (43.33)	69 (38.33)	16 (53.33)	97 (53.89)	12 (40.00)	86 (47.78)	12 (40.00)
Christian	56 (31.11)	11 (36.67)	46 (25.56)	5 (16.67)	53 (29.44)	13 (43.33)	31 (17.22)	4 (13.33)
Muslim	25 (13.89)	6 (20.00)	65 (36.11)	9 (30.00)	30 (16.67)	5 (16.67)	63 (35.00)	14 (46.67)
Chisquare	NS		NS		NS		NS	
Caste								
Forward	115 (63.89)	14 (46.67)	66 (36.67)	12 (40.00)	100 (55.56)	18 (60.00)	59 (32.78)	20 (43.33)
SC	21 (11.67)	4 (13.33)	26 (14.44)	5 (16.67)	32 (17.78)	3 (10.00)	31 (17.22)	3 (10.00)
OBC	44 (24.44)	12 (40.00)	88 (48.89)	13 (43.33)	48 (26.66)	9 (30.00)	90 (50.00)	7 (46.67)
Chisquare	NS		NS		NS		NS	
Family Type								
Nuclear	164 (91.11)	27 (90.00)	153 (85.00)	18 (60.00)	175 (97.22)	24 (80.00)	145 (80.56)	21 (70.00)
Joint	16 (8.89)	3 (10.00)	27 (15.00)	12 (40.00)	5 (2.78)	6 (20.00)	35 (19.44)	9 (30.00)
Chisquare	NS		10.63**		15.37**		NS	
Family size								
Small	139 (77.22)	23 (76.67)	127 (70.56)	18 (60.00)	135 (75.00)	21 (70.00)	119 (66.11)	19 (63.34)
Medium	39 (21.67)	4 (13.33)	43 (23.89)	7 (23.33)	41 (22.78)	5 (16.67)	41 (22.78)	7 (23.33)
Large	2 (1.11)	3 (10.00)	10 (5.55)	5 (16.67)	4 (2.22)	4 (13.33)	20 (11.11)	4 (13.33)
Chisquare	9.41**		NS		8.85*		NS	

(*Percentages given in parenthesis) * Significant at 5 percent level, ** Significant at 1 percent level

Table 9. Area wise and sex wise distribution of overweight and normal weight children based on sibling constellation

Number Of Siblings	Urban Boys		Rural Boys		Urban Girls		Rural Girls	
	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
None	23 (12.78)	7 (23.33)	14 (7.77)	2 (6.67)	18 (10.00)	3 (10.00)	17 (9.44)	1 (3.33)
One	134 (74.44)	13 (43.33)	125 (69.44)	13 (43.33)	151 (83.89)	14(46.67)	128 (71.11)	15 (50.00)
Two	13 (7.22)	6 (20.00)	30 (16.67)	7 (23.33)	9 (5.00)	8 (26.67)	15 (8.33)	9 (30.00)
Three	10 (5.56)	4 (13.33)	11 (6.11)	8 (26.67)	2 (1.11)	5 (16.67)	20 (11.11)	5 (16.67)
Chisquare	12.47**		9.8**		35.70**		10.90**	
Ordinal Position								
First	94 (52.22)	9 (30.00)	85 (45.22)	5 (16.67)	79 (43.88)	9 (30.00)	63 (35.00)	7 (23.33)
Middle	24 (13.33)	13 (43.33)	40 (22.22)	14 (46.67)	33 (18.33)	12 (40.00)	51 (28.33)	13 (43.33)
Last	62 (34.44)	8 (26.67)	55 (30.56)	11 (36.67)	68 (37.78)	9 (10.00)	66 (36.67)	10 (33.33)
Chisquare	16.19**		11.88**		7.24*		NS	

(* Percentages given in parenthesis) * Significant at 5 percent level, ** Significant at 1 percent level

Table 10. Area wise and sex wise distribution of overweight and normal weight children based on birth history

	Urban Boys		Rural Boys		Urban Girls		Rural Girls	
	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
Birth weight								
< 2.5 kg	18 (10.00)	2 (6.66)	20 (11.11)	2 (6.67)	22 (12.22)	1 (3.33)	17 (9.44)	2 (6.67)
>2.5kg	162 (90.00)	28 (93.33)	160 (88.89)	28 (93.33)	158 (87.78)	29 (96.67)	163 (90.55)	28 (93.33)
Chi Square	NS		NS		NS		NS	
Pregnancy term Of mothers								
Preterm	15 (8.33)	2 (6.67)	19 (10.56)	2 (6.67)	22 (12.22)	1 (3.33)	16 (8.89)	1 (3.33)
Term	165 (91.67)	28 (93.33)	161 (89.44)	28 (93.33)	158 (87.78)	29 (96.67)	164 (91.11)	29 (96.67)
Chi Square	NS		NS		NS		NS	
Breast Feeding								
Not Given	7 (3.89)	1 (3.33)	4 (2.22)	-	6 (3.33)	1 (3.33)	5 (2.78)	-
<6months	11 (6.11)	3 (10.00)	8 (4.44)	1 (3.33)	9 (6.67)	2 (6.67)	12 (6.67)	1 (3.33)
6-1yr	57 (31.67)	13 (43.33)	35 (19.44)	10 (30.00)	62 (34.44)	12 (40.00)	69 (38.33)	12 (40.00)
>1 yr	105 (58.33)	13 (43.33)	133 (73.89)	19 (63.33)	103 (57.22)	15 (50.00)	94 (52.22)	17 (56.67)
Chi Square	NS		NS		NS		NS	
Obesity In Family								
Present	153 (85.00)	15 (50.00)	145 (80.56)	12 (40.00)	143 (79.44)	14 (46.67)	137 (76.11)	13 (43.33)
Absent	27 (15.00)	15 (50.00)	35 (19.44)	18 (60.00)	37 (20.56)	16 (53.33)	43 (23.89)	17 (56.67)
Chi Square	19.69**		22.41**		14.60**		13.53**	

(* Percentages given in parenthesis), * Significant at 5 percent level, ** Significant at 1 percent level

Table 11. Area wise and sex wise distribution of overweight and normal children based on educational status of parents

	Urban Boys		Rural Boys		Urban Girls		Rural Girls	
Education	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
Father								
Below SSLC	0 (0.00)	0 (0.00)	2 (1.11)	0 (0.00)	1 (0.55)	0 (0.00)	4 (2.22)	1 (3.33)
SSLC	8 (4.44)	1 (3.33)	11 (6.11)	3 (10.00)	6 (3.33)	3 (10.00)	12 (6.67)	5 (16.67)
Pre-degree	23 (12.78)	3 (10.00)	18 (10.00)	5 (16.67)	15 (8.33)	4 (13.33)	50 (27.78)	10 (33.33)
Degree	50 (27.78)	6 (20.00)	45 (25.00)	7 (23.33)	46 (25.56)	7 (23.33)	47 (26.11)	5 (16.67)
Masters/ Professional	99 (55.00)	20 (66.67)	104 (57.78)	15 (50.00)	112 (62.22)	16 (53.34)	67 (37.22)	9 (30.00)
Mother								
Below SSLC	2 (1.11)	0 (0.00)	5 (2.78)	1 (3.33)	3 (1.67)	0 (0.00)	3 (1.67)	2 (6.67)
SSLC	9 (5.00)	2 (6.67)	8 (4.44)	4 (13.33)	13 (7.22)	3 (10.00)	15 (8.33)	5 (16.67)
Pre-degree	32 (17.78)	8 (26.67)	39 (21.67)	15 (50.00)	45 (25.00)	5 (16.67)	66 (36.67)	13 (43.33)
Degree	73 (40.56)	13 (43.33)	45 (25.00)	3 (10.00)	81 (45.00)	11 (36.67)	58 (32.22)	4 (13.33)
Masters / Professional	75 (41.67)	7 (23.34)	45 (25.00)	7(23.33)	66 (6.17)	11 (36.67)	37 (20.55)	6 (19.99)

(* Percentages given in parenthesis)

Table 12. Area wise and sex wise distribution of overweight and normal children based on employment status of parents

Employment	Urban Boys		Rural Boys		Urban Girls		Rural Girls	
	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
Father								
Govt. Employee	32 (17.78)	14 (46.67)	27 (15.00)	4 (13.33)	27 (15.00)	11 (36.67)	37 (20.56)	3 (10.00)
Private employee	90 (50.00)	6 (20.00)	37 (20.56)	7 (23.33)	97 (53.89)	4 (13.33)	33 (18.33)	5 (16.67)
Self employed	24 (13.33)	2 (6.67)	48 (26.67)	11 (36.67)	28 (15.56)	8 (26.67)	28 (15.56)	13 (43.33)
Working abroad	33 (18.33)	8 (26.67)	66 (36.67)	8 (26.67)	27 (15.00)	7 (23.33)	79 (43.89)	9 (30.00)
Unemployed	1 (0.55)	-	2 (1.11)	-	1 (0.55)	-	3 (1.67)	-
Mother								
Govt. Employee	51 (28.33)	11 (36.67)	10 (5.55)	2 (6.67)	45 (25.00)	9 (30.00)	27 (15.00)	4 (13.33)
Private employee	63 (35.00)	4 (13.33)	42 (23.33)	3 (10.00)	81 (45.00)	3 (10.00)	13 (7.22)	2 (6.67)
Self employed	25 (13.89)	2 (6.67)	10 (5.55)	2 (6.67)	7 (3.89)	-	11 (6.11)	5 (16.67)
Working abroad	13 (7.22)	1 (3.33)	7 (3.89)	-	1 (0.55)	2 (6.67)	-	2 (6.67)
House wife	28 (15.55)	12 (40.00)	111 (61.67)	23 (76.67)	46 (25.56)	16 (53.33)	129 (71.67)	17 (56.67)

(* Percentages given in parenthesis)

Table 13. Area wise and sex wise distribution of overweight and normal children based on monthly family income

Income Group	Amount In Rs.	Urban Boys		Urban Girls		Rural Boys		Rural Girls	
		Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
Low Income	<1000	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0(0.00)	2 (6.67)	2 (1.11)	1 (3.33)
Lower Middle	1000-5000	5 (2.78)	2 (6.67)	21 (11.67)	6 (20.00)	34 (18.89)	7 (23.33)	27 (15.00)	9 (30.00)
Middle Income	5000-20,000	88 (48.89)	18 (60.00)	57 (31.67)	17 (56.67)	94 (52.22)	15 (50.00)	69 (38.33)	13 (43.33)
Upper Middle	20,000-50,000	65 (36.11)	7 (23.33)	71 (39.44)	5 (16.67)	43 (23.89)	4 (13.33)	55 (30.56)	3 (10.00)
High Income	>50,000	22 (12.22)	3 (10.00)	31 (17.22)	2 (6.67)	9 (5.00)	2 (6.67)	27 (15.00)	4 (13.33)
Chi Square		12.01**				5.47*			

(* Percentages given in parenthesis), * Significant at 5 percent level, ** Significant at 1 percent level

Table 14. Area wise and sex wise distribution of overweight and normal children based on monthly family expenditure pattern

Items of expenditure	Amount In Rs	Urban Boys		Rural Boys		Urban Girls		Rural Girls	
Food		Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
	< 500	0 (0.00)	0 (0.00)	5 (2.78)	1(3.33)	0 (0.00)	0 (0.00)	9 (5.00)	1(3.33)
	500-1500	95 (52.78)	21 (70.00)	97 (53.89)	24 (80.00)	83 (46.11)	21 (70.00)	99 (55.00)	23(76.67)
	1500 -3000	63 (35.00)	9 (30.00)	58 (32.22)	5 (16.66)	79 (43.89)	8 (26.67)	65 (36.11)	6 (20.00)
	> 3000	22 (12.22)	0(0.00)	20 (11.11)	0 (0.00)	18 (10.00)	0 (0.00)	7 (3.89)	0 (0.00)
Clothing	< 500	138 (76.67)	25 (83.33)	154 (85.56)	27 (90.00)	147 (81.67)	27 (90.00)	169 (93.89)	26(86.67)
	500 – 1500	39 (21.67)	5 (16.67)	26 (14.44)	3 (10.00)	32 (17.78)	3 (10.00)	11(6.11)	4 (13.33)
	1500 -3000	2 (1.11)	0 (0.00)	0 (0.00)	0 (0.00)	1(0.55)	(0.00)	0 (0.00)	0 (0.00)
	> 3000	1(0.55)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	(0.00)	0 (0.00)	0 (0.00)
Housing	< 500	56(31.11)	3 (10.00)	43 (23.89)	3 (10.00)	61 (33.89)	2 (6.66)	52 (28.89)	4 (13.33)
	500 – 1500	27 (15.00)	7 (23.33)	59 (32.78)	7 (23.33)	34 (18.89)	12 (40.00)	51 (28.33)	11(36.67)
	1500 -3000	35 (19.44)	11 (36.67)	68 (37.78)	14 (46.67)	46 (25.56)	10 (33.33)	54 (30.00)	12(12.00)
	> 3000	62 (34.44)	9 (30.00)	10 (5.56)	6 (20.00)	39 (21.67)	6 (20.00)	23 (12.78)	3 (10.00)
Travel	< 500	37 (20.56)	3 (10.00)	55 (30.56)	5 (16.66)	26 (14.44)	4 (13.33)	47 (26.11)	3 (10.00)
	500 – 1500	75 (41.67)	21 (70.00)	89 (49.44)	24 (80.00)	81(45.00)	20 (66.67)	96 (53.33)	25(83.33)
	1500 -3000	45 (25.00)	4 (13.33)	36 (20.00)	1 (3.33)	39 (21.67)	3 (10.00)	28 (15.56)	2 (6.66)
	> 3000	23 (12.78)	2 (6.67)	0 (0.00)	0 (0.00)	34 (18.89)	3 (10.00)	9 (5.00)	0 (0.00)

(* Percentages given in parenthesis)

Table 14….continued . Area wise and sex wise distribution of overweight and normal children based on monthly family expenditure pattern

Items of expenditure	Amount In Rs	Urban Boys		Rural Boys		Urban Girls		Rural Girls	
		Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
Education	< 500	2 (1.11)	0 (0.00)	9 (5.00)	2 (6.67)	7 (3.89)	1(3.33)	11(6.11)	1(3.33)
	500-1500	39 (21.67)	6 (20.00)	57 (31.67)	9 (30.00)	52 (28.89)	5(16.67)	66 (36.67)	11(36.67)
	1500 -3000	78 (43.33)	17 (56.67)	92 (51.11)	13 (43.33)	83 (46.11)	15 (50.00)	89 (49.11)	12(40.00)
	> 3000	61 (33.89)	7 (23.33)	22 (12.22)	6 (20.00)	38 (21.11)	9 (30.00)	14 (7.78)	6 (20.00)
Leisure	< 500	139 (77.22)	23 (76.67)	157 (87.22)	27 (90.00)	127 (70.56)	24 (80.00)	164 (91.11)	28(93.33)
	500 – 1500	27 (15.00)	6 (20.00)	23 (12.78)	3 (10.00)	49 (27.22)	4(13.33)	16 (8.89)	2 (6.66)
	1500 -3000	14 (7.78)	1 (3.33)	0 (0.00)	0 (0.00)	4 (2.22)	2 (6.66)	0 (0.00)	0 (0.00)
	> 3000	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Healthcare	< 500	93 (51.67)	14 (46.67)	98 (54.44)	18 (60.00)	74 (41.11)	12 (40.00)	106 (58.89)	21(70.00)
	500 – 1500	65 (36.11)	13 (43.33)	78 (43.33)	7 (23.33)	93 (51.67)	13 (43.33)	65 (36.11)	8(26.67)
	1500 -3000	13 (7.22)	2 (6.66)	4 (2.22)	5 (16.67)	7 (3.89)	3 (10.00)	9 (5.00)	1 (3.33)
	> 3000	9 (5.00)	1 (3.33)	0 (0.00)	0 (0.00)	6 (3.33)	2 (6.67)	0 (0.00)	0 (0.00)
Savings	< 500	23 (12.78)	4 (13.33)	37 (20.56)	7 (23.33)	17 (9.44)	6 (20.00)	43 (23.89)	6 (20.00)
	500 – 1500	37 (20.56)	7 (23.33)	76 (42.22)	13 (43.33)	61 (33.89)	5 (16.67)	65 (36.11)	14(13.33)
	1500 -3000	68 (37.78)	13 (43.33)	34 (18.89)	6 (20.00)	45 (25.00)	15 (50.00)	42 (23.33)	7(23.33)
	> 3000	52 (28.89)	6 (20.00)	33 (18.33)	4 (13.33)	57 (31.67)	4 (13.33)	30 (16.67)	3 (10.00)
Other	< 500	57 (31.67)	11 (36.67)	125 (69.44)	17 (56.67)	65 (36.11)	13 (43.33)	116 (64.44)	16(53.33)
	500 – 1500	77 (42.78)	14 (46.67)	43 (23.89)	13 (43.33)	83 (46.11)	12 (40.00)	58 (32.22)	12(40.00)
	1500 -3000	36 (20.00)	4 (13.33)	12 (6.67)	0 (0.00)	29 (16.11)	3 (10.00)	6 (3.33)	2 (6.66)
	> 3000	10 (5.56)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)

(* Percentages given in parenthesis)

4.2.5 Quality of Life

Details regarding the existing facilities in their houses were collected to assess the living conditions of the subjects. The parameters included were type of the house, availability of basic facilities and amenities.

Type of House: Under the type of house, the roof, floor and wall of the houses were studied to find out their living conditions. Ninety per cent of the overweight subjects and normal weight children had own houses even though the percentage of overweight children having own houses were higher than that of normal weight children. Therefore, higher percentage of normal weight children were living in rented houses compared to that of overweight children. The percentage of children living in quarters provided by employers' of their parents was comparatively very low in both overweight and normal weight groups of children.

Irrespective of their weight or area wise difference, 86 per cent of the overweight and normal weight children had concrete roofing for their houses. Tile roofing was also found in a lesser number of houses. Sheets and thatched roofing were not at all seen in the houses of either overweight or normal children. Almost all the children, irrespective of area and weight status had brick wall for their houses. The tile, mosaic, marble and granite floorings in houses were more or less equal in both overweight and normal weight groups.

Basic Utility Services: The basic utility services like water, electricity, bathrooms and proper sewage were available for all the overweight as well as normal weight control subjects. When all the rural children resorted to well water, all of the urban children made use of corporation water. Seven per cent of urban children had both well water and corporation water facilities. Electric connections were available for all of the subjects irrespective of area and weight status. Attached bath rooms were present in the houses of majority of the overweight as well as normal weight children. All of the urban children had public sewage facilities when rural children resorted to private sewage facilities.

Amenities Available: As the standard of living rises, most houses have better facilities, which included electrical appliances, transport facilities, printed media and kitchen appliances. All of the overweight children had at least 3-4 electrical appliances and kitchen appliances in their houses. In case of transport facilities, 92 percent of the

overweight and normal weight children had at least 2 vehicles in their houses. Ninety five per cent of the houses also had at least one printed media like news paper and magazines in their houses. The amenities were more or less similar in families of rural and urban overweight and normal weight children.

Eighty nine per cent of overweight children had full time or part time house servants in their houses whereas only 49 percent normal weight children had house servants. It was also observed from the study that 85 per cent of overweight and normal weight children had their own rooms in their houses.

As indicated in corresponding tables, when the socio demographic and familial background of the overweight rural and urban boys and girls were compared with normal weight children some of the variables showed some difference between groups. In order to see whether there was any significant association with these variables and overweight statistical analysis namely Chi square was done. Among various socioeconomic and familial factors analysed statistically, monthly family income, and family history of overweight and obesity were found to have a significant association with overweight.

4.3 Dietary Profile and Food Consumption Pattern

Food habits of the respondents were assessed with regard to their dietary habits, food fads and fallacies, nibbling habits, habit of dining out, habit of buying food from hotels, frequency of consumption of carbonated beverages, opinion on dieting etc. The results obtained are presented in tables 15, 16 and 17.

4.3.1 Food habits

The data presented in Table 15 revealed that all the overweight subjects in both rural and urban areas were non-vegetarians. Among normal weight children also 90 per cent to 96.67 percent were found to be non vegetarians among the different groups. Statistical analysis of the data using chi square revealed a high relationship between the vegetarianism/non -vegetarianism and overweight in both boys (16.78**) and girls (11.76**).

Food fads and fallacies of the subjects were also assessed. Questions regarding opinion on dieting revealed that 33.89 per cent to 43.33 per cent of the overweight and normal boys in different groups believed that dieting is bad while 46.67 per cent to 53.33 per cent of girls in different groups in rural and urban areas had the opinion that dieting

is good regardless of their weight status. When more boys considered dieting as bad, more girls considered dieting as good. Statistical analysis of the data revealed that the opinion on dieting did not have any relationship with the weight status.

Nibbling habits were found in both overweight and normal weight children. However, the percentage of overweight children having snacking habits was much higher (83-89 per cent) compared to that of normal weight children (49-54 per cent). When the children's preference on food from outside was asked, it was seen that most of them preferred home made food to outside food irrespective of area or sex. But in the case of overweight children more than 50 per cent of them preferred food from both home and outside whereas it was far low in the case of normal weight children. Upon statistical analysis of the data using chi square, food preference was found to have a significant association (at 1 per cent level) with overweight in both boys (11.50**) and girls (22.40**).

Table 15 also illustrates that the percentage of urban overweight children eating out daily or weekly is much higher than their rural counterparts. Frequency of eating out was limited to monthly or less frequent in majority of the normal weight children. Frequency of eating out was also found to have a significant association with overweight in urban boys (30.26**), rural boys (17.28**), urban girls (14.46**) and rural girls (19.69**). Similarly, significant difference was seen between overweight and normal weight children with the use of carbonated beverages. Carbonated beverages were frequently or regularly used by overweight boys and girls of both rural and urban areas. But the consumption of the same was very rare in the case of 90 per cent of the normal weight children and was particularly nil among rural boys and girls. The results revealed differences between normal weight children and overweight children in their practices of eating out and in the use of commercially available sweetened juices and carbonated beverages regardless of sex and area. Statistical analysis of the data using chi square also revealed a close and significant association between overweight and the use of sweetened juices/ carbonated beverages in urban boys (27.17**), rural boys (17.28**), urban girls (11.00**) and rural girls (13.20**).

4.3.2 Food Use Frequency

The frequency of use of different foods in general was assessed by means of a check list in which the common and locally popular food items of the major food groups were listed down and subjects rated it according to their frequency of use ranging from daily use to very rare use. The details of frequency of use of food were calculated based on the modality suggested by Reaburn et al. (1979). The mean food use frequency score computed for urban and rural adolescents on the basis of the frequency of consumption of each item is given in Table 16. It can be seen that the scores varied from 25 to 100 for different food items.

The results revealed that when there was variation between overweight and normal weight children in the food use frequency of some of the food groups, for other food groups it was more or less the same irrespective of sex or area wise variation.

As presented in Table 16, when the food use frequency of overweight and normal weight children were compared, cereals, fats and oils, nuts and oilseeds, sugar, spices and condiments used in the preparation of food and beverages which are included in the daily diet had the highest scores in both the groups. The next highest consumption was for fish and sea foods where the score was 90 for all the groups. This was followed by milk and milk products. In the case of consumption of vegetables other than green leafy vegetables, the score was more or less similar ranging from 80-90. In the case of consumption of fruits also there was not much difference noted between overweight children and normal weight children.

In all other cases variations were seen between overweight and normal weight children. It could be seen that when the consumption of green leafy vegetables were comparatively low for the overweight children (48-55), the consumption was much better and more frequent in normal weight groups (58-64). Similarly in the case of roots and tubers also the food consumption scores were better reflecting more frequent use among normal weight children than overweight children.

Much variation was seen between the two groups in other food groups included in the diet. The results pointed out that the consumption was almost double in the case of overweight children for egg, meat, fast foods, hotel/canteen foods, sweets and desserts. The egg consumption score ranged form 80-84 in overweight children, when it was 40-48

in normal weight children. Similarly, the food use frequency score of meat group ranged from 83-89 in overweight children when the score for the same was only 43-49 among normal weight children indicating more frequent consumption of meat, meat products and egg by overweight children.

There was not much sex wise difference observed in the food frequency use of overweight and normal weight children and similarly area wise difference in food frequency use was also negligible.

4.3.3 Food Preference

As in food use frequency, the preference for food items in different food groups was assessed using a checklist (Table 17). Preference score of different food groups and other food items were calculated using the same method as suggested by Reaburn et al. (1979). The scores varied from 60 to 100 for different items.

The food preference score of cereals and pulses were high in both overweight and normal weight children with scores ranging from 90.50 to 100. The preference score of green leafy vegetables, other vegetables and roots and tubers were lower in overweight children compared to that of normal weight children. Fruit, fish and milk preference score of both overweight and normal weight children were higher ranging from 87 to 99.

The meat and egg preference scores of overweight children were much higher than that of normal weight children. The preference score for fats, oil seeds, sugar, beverages and spices were relatively high ranging form 95 to 100 for both overweight and normal weight children whereas the preference scores for hotel/ canteen foods, fast foods, sweets, snacks and desserts were very high in overweight children than normal weight children.

As with food use frequency, the sex wise and area wise difference in food preference was also found to be negligible among the overweight and normal weight children.

Table 15. Area wise and sex wise distribution of overweight and normal weight children based on their food habits

	Urban Boys		Rural Boys		Urban Girls		Rural Girls	
	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
Diet Preference								
Non -Vegetarian	180 (100.00)	27 (90.00)	180 (100.00)	29 (96.67)	180 (100.00)	28 (93.33)	180 (100.00)	29 (96.67)
Vegetarian	0 (0.00)	3 (10.00)	0 (0.00)	1 (3.33)	0 (0.00)	2 (6.67)	0 (0.00)	1 (3.33)
Chi Square	16.78**				11.76**			
Opinion on dieting								
Good	67 (37.22)	11 (36.67)	61 (33.89)	13 (43.33)	95 (52.78)	16 (53.33)	92 (51.11)	14 (46.67)
Bad	113 (62.78)	19 (63.33)	119 (66.11)	17 (56.67)	85 (47.22)	14 (46.67)	88 (48.89)	16 (53.33)
Chi Square	NS				NS			
Food Preference								
Home food	37 (20.56)	14 (46.67)	59 (32.78)	15 (50.00)	42 (23.33)	17 (56.67)	62 (34.44)	19 (63.33)
Outside food	25 (13.89)	5 (16.67)	20 (11.11)	6 (20.00)	23 (12.78)	7 (23.33)	23 (12.78)	6 (20.00)
Both	118 (65.56)	11 (36.67)	101 (56.11)	9 (30.00)	115 (63.89)	6 (20.00)	95 (52.78)	5 (16.67)
Chi Square	11.50**				22.40**			

(* Percentages given in parenthesis), * Significant at 5 percent level, ** Significant at 1 percent level

Table 15….continued Area wise and sex wise distribution of overweight and normal weight children based on their food habits

	Urban Boys		Rural Boys		Urban Girls		Rural Girls	
	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)	Overweight (n=180)	Normal (n=30)
Frequency of eating out								
Daily	23 (12.78)	-	7 (3.89)	-	17 (9.44)	1 (3.33)	8 (4.44)	-
Weekly	95 (52.78)	3 (10.00)	67 (37.22)	-	84 (46.67)	4 (13.33)	72 (40.00)	-
Monthly	58 (32.22)	10 (33.33)	89 (49.44)	16 (53.33)	69 (38.33)	13 (43.33)	91 (50.56)	11(36.67)
Rarely	4 (2.22)	17 (56.66)	17 (9.44)	14 (46.67)	10 (5.56)	12 (40.00)	9 (5.00)	19 (63.33)
Chi Square	30.26**		17.28**		14.46**		19.69**	
Frequency of use of sweet/ carbonated beverages								
Daily	18 (8.33)	-	12 (6.67)	-	15 (8.33)	-	11 (6.11)	-
Weekly	84 (46.67)	1 (3.33)	62 (34.44)	-	64 (33.56)	3 (10.00)	53 (29.44)	-
Monthly	61 (33.89)	19 (63.33)	51 (28.33)	14 (46.67)	54 (30.00)	15 (50.00)	67 (37.22)	13 (43.33)
Rarely	17 (9.44)	10 (33.33)	55 (30.56)	16 (53.33)	47 (26.11)	12 (40.00)	49 (27.22)	17 (56.67)
	27.17**		17.28**		11.00**		13.70**	

(* Percentages given in parenthesis), * Significant at 5 percent level, ** Significant at 1 percent level

Table 16. The food use frequency scores obtained by overweight and normal weight children for different food groups

Food Groups	Overweight Group				Normal weight Group			
	Urban		Rural		Urban		Rural	
	Boys (n =180)	Girls (n =180)	Boys (n =180)	Girls (n =180)	Boys (n =30)	Girls (n =30)	Boys (n = 30)	Girls (n = 30)
Cereals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Pulses	68.80	62.94	71.62	73.51	68.33	69.87	65.74	70.86
Green leafy vegetables	53.00	48.50	54.80	49.80	58.33	62.50	63.70	61.20
Other vegetables	84.15	82.20	81.50	87.70	85.83	86.60	89.10	89.50
Roots and tubers	53.15	57.80	56.20	54.60	62.50	65.50	69.10	64.30
Fruits	55.90	49.90	57.60	55.55	53.35	52.80	51.00	56.80
Milk and milk products	87.75	91.30	89.25	89.90	88.33	92.80	93.40	93.00
Meat	88.97	83.60	87.88	89.00	43.33	47.50	49.60	48.50
Fish and other sea foods	93.07	95.00	91.70	96.10	90.00	94.20	92.70	91.00
Egg	83.70	79.80	80.40	81.30	45.00	39.80	44.40	48.20
Fats and oils	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Oil seeds and nuts	100.00	95.00	100.00	100.00	100.00	100.00	100.00	100.00
Sugar	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Spices and condiments	99.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Hotel / Canteen foods	67.33	66.40	61.40	60.20	38.33	39.30	25.20	29.10
Fast foods	89.03	85.22	80.10	79.50	51.66	50.20	45.20	43.40
Sweets	80.13	78.30	79.80	82.30	51.66	52.30	55.50	53.40
Snacks	87.12	89.20	84.70	83.20	50.83	51.35	54.30	49.90
Desserts	72.7	75.50	70.70	79.00	46.67	49.50	41.70	48.80
Beverages	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 17. The food preference scores obtained by overweight and normal weight children for different food groups

Food Groups	Overweight Group				Normal weight Group			
	Urban		Rural		Urban		Rural	
	Boys (n =180)	Girls (n =180)	Boys (n =180)	Girls (n =180)	Boys (n = 30)	Girls (n = 30)	Boys (n = 30)	Girls (n = 30)
Cereals	98.00	98.60	100.00	94.00	99.50	100.00	100.00	100.00
Pulses	90.50	98.00	95.50	91.50	95.50	97.60	93.40	98.50
Green leafy vegetables	71.35	78.56	72.67	74.12	83.40	84.50	81.10	87.50
Other vegetables	83.45	82.00	78.00	81.60	89.50	91.45	90.55	92.30
Roots and tubers	72.50	73.70	86.50	81.40	83.40	85.10	79.60	89.50
Fruits	96.00	94.00	92.00	97.00	98.00	97.00	95.00	99.00
Milk and milk products	87.00	91.00	93.00	96.00	92.30	90.00	95.00	93.00
Meat	98.90	99.00	96.00	98.00	79.50	85.60	83.50	80.10
Fish and other sea foods	96.00	97.00	99.00	97.50	95.00	94.00	97.50	99.50
Egg	91.00	87.00	81.50	83.30	69.50	73.59	71.40	75.00
Fats and oils	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Oil seeds and nuts	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Sugar	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Spices and condiments	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Hotel / Canteen foods	95.00	92.00	98.50	94.00	74.50	69.00	61.67	69.50
Fast foods	98.00	100.00	99.50	98.00	88.20	85.40	81.20	86.50
Sweets	93.70	91.00	94.00	93.00	85.50	79.60	83.50	87.00
Snacks	100.00	100.00	100.00	100.00	91.00	89.50	81.50	84.50
Desserts	92.00	90.00	93.00	89.00	86.00	89.50	85.00	88.00
Beverages	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

4.3.4 Dietary Pattern and Dietary Adequacy

The food preference and consumption score and food intake pattern (Table 15, 16 and 17) revealed that the diets of overweight children comprised mostly of energy dense foods and other sugary and fatty fast foods whereas the consumption was low on vegetables and fruits etc. From a review of the meal pattern of the subjects, it was found that the skipping of breakfast was more common in overweight children. A good majority of the overweight children were having energy dense foods and beverages from school canteens and nearby bakeries during school breaks. The daily intake of non-vegetarian items was also frequent in overweight children than that of normal weight children. From the menu pattern it was also noticed that milk intake was more common among younger children than that of older children. Evening tea with energy dense bakery items and fast food items were common in overweight children than that of normal weight children and this was mostly followed by a heavy dinner comprising of items like parotta, chappathi, chicken etc. Vegetable preparations especially green leafy vegetable preparations were very low in the meals of overweight as well as normal weight children.

In order to see whether the daily dietary intake of the subjects was adequate qualitatively and quantitatively, in-depth analysis was done on the micro sample selected from the macro sample.

The dietary adequacy of the micro sample was assessed from the weighment survey by taking the raw and cooked weight of the food consumed by each subject. Comparison was made between overweight and normal weight boys and girls of both rural and urban areas. For making the comparison of nutritional adequacy easier, children were also grouped into 10-12 and 13-15 year age groups and the results are presented in the Table18 and 19.

Results of the weighment survey indicated (Table 18 and 19) that a significant difference existed in the intake of food groups like meat, fish, eggs and fast foods among overweight and normal weight children of both 10-12 and 13-15 age groups irrespective of the area. For cereal intake, overweight children of 10-12 years had significantly higher intake than their normal weight counterparts. No significant difference was noted in the cereal intake of 13-15 year old overweight and normal weight children. A detailed

observation revealed that compared to all the food groups, intake of fast foods had the highest‘t’ values with significant difference at 1 per cent level in both age groups. The ‘t ‘ values also revealed that the intake of fast foods had even higher significant difference in 13- 15 year olds than 10-12 year olds.

The sugar and fat /oil intake of overweight children were higher and above RDA requirements than the normal weight children of both age groups. However, the difference was found to be statistically not significant. Similarly, the difference in the intake of food groups like pulses, fruits and milk in overweight and normal weight children of both age groups was also found to be not significant. But the consumption was very low compared to RDA The consumption of green leafy vegetables was generally lower in both overweight and normal weight children. However, the green leafy vegetable intake was still lower in overweight children of both age groups than that of their normal weight counterparts. For the consumption of other vegetables, a significant difference at 1 percent level (3.31**) was observed between urban overweight and normal weight children of 10-12 years age group while this difference was not significant in all other groups. But the intake of vegetables was lower than normal weight children for all age groups.

When the area wise comparison of food intake between urban and rural boys and girls of 10-12 and 13-15 age groups were made, no noticeable difference was found in the intake of cereals, pulses, other vegetables, milk group, sugar and fats. However, the meat, fish and egg intake of rural overweight children was evidently higher than that of urban overweight children. And the fast food intakes of urban overweight children were markedly higher than that of their rural counterparts. The intake of green leafy vegetables was considerably lower in both overweight and normal weight urban children compared to that of rural children.

The consumption of green leafy vegetables was significantly lower in urban overweight boys (3.76**) and urban overweight girls (3.69**) in the 10-12 age group, and among overweight urban girls (2.52*), urban overweight boys (2.55*) in the 13-15 age group compared to their normal weight counterparts. This difference was insignificant in rural overweight and normal weight children of both age groups.

Also the results were further compared with RDA to see whether the diet was meeting recommended allowance for each group. The intake of food groups like cereals, meat, fish and eggs, fats and oils, and sugars had exceeded in urban and rural overweight children of both 10-12 and 13-15 age groups. But the intakes of normal weight children were lower than the RDA. Overweight as well as normal weight children were found to have pulse intake slightly lower than the RDA. It was interesting to note that the RDA of milk was met in majority of 10-12 year olds irrespective of their weight status, when none of the groups in 13-15 year olds have met the RDA for milk indicating a reduction in milk intake with increasing age. The RDA for green leafy vegetables was not met by any of the overweight or normal weight children. The RDA for fruits was found to be slightly lower but closer to the RDA requirements in most of the groups of overweight and normal weight children.

On the whole, the adequacy of the food intake was not up to the mark in any of the groups studied as it could be seen that RDA requirements of green leafy vegetables, milk, fruits , pulses etc are not met in either overweight or normal weight children studied suggesting urgent need for improvement.

4.3.4 Dietary Adequacy

Table18. Area and sex wise comparison of food intake of 10-12 years old overweight and normal weight children

	Group	Cereals	Pulses	Green Leafy vegetables	Other vegetables	Fruits	Milk	Fats & oils	Meat, fish & eggs	Sugar & jaggery	Fast foods
	RDA	290.00 (gms)	60.00 (gms)	100.00 (gms)	75.00 (gms)	100.00 (gms)	400.00 (ml)	30.00 (gms)	60.00 (gms)	30.00 (gms)	(gms)
Rural Girls	Overweight	292.67	35.56	51.67	72.11	94.22	408.89	34.22	126.11	32.22	150.11
	Normal	256.00	38.33	25.5	84.17	98.33	293.33	26.17	76.83	24.17	67.17
	t-values	3.75**	NS	NS	NS	NS	NS	2.16*	4.72**	NS	6.87**
Rural Boys	Overweight	308.11	46.11	53.56	75.33	75.00	408.89	34.00	127.78	34.44	168.89
	Normal	273.00	48.33	71.83	86.33	88.83	413.33	28.67	73.33	30.50	53.67
	t-values	2.86*	NS	NS	NS	NS	NS	NS	6.65**	NS	6.19**
Urban Girls	Overweight	300.22	57.33	11.67	68.11	98.44	395.56	37.22	119.22	36.44	177.78
	Normal	266.67	45.83	63.33	84.33	91.67	336.67	27.50	66.67	25.83	63.33
	t-values	2.68**	NS	3.69**	NS	NS	NS	NS	4.69**	NS	7.9**
Urban Boys	Overweight	306.00	51.56	7.77	54.44	72.33	422.20	35.00	112.00	37.00	209.44
	Normal	267.50	40.33	43.17	95.50	86.67	403.33	31.00	74.5	29.83	58.67
	t-values	2.16*	NS	3.76**	3.31**	NS	NS	NS	6.03**	NS	9.80**

NS – Not Significant, * Significant at 5 percent level, ** Significant at 1 percent level

Table19. Area and sex wise comparison of food intake of 13 -15 years old overweight and normal weight children

	Group	Cereals	Pulses	Green Leafy vegetables	Other vegetables	Fruits	Milk	Fats & oils	Meat, fish & eggs	Sugar & jaggery	Fast foods
	RDA	400.00 (gms)	50.00 (gms)	100.00 (gms)	75.00 (gms)	100.00 (gms)	400.00 (gms)	30.00 (gms)	80.00 (gms)	30.00 (gms)	(gms)
Rural Girls	Overweight	404.78	56.44	35.56	82.33	91.67	184.44	33.56	198.89	35.22	222.78
	Normal	361.17	52.83	66.67	91.83	103.33	216.67	33.17	86.67	30.83	80.67
	t-value	NS	NS	NS	NS	NS	NS	NS	7.19**	NS	10.56**
Rural Boys	Overweight	400.00	45.89	39.22	85.33	92.33	208.89	37.89	195.11	35.56	247.22
	Normal	372.00	44.00	47.83	80.50	98.00	120.00	29.83	87.00	27.67	71.67
	t-value	3.18**	NS	NS	NS	NS	NS	1.92*	6.49**	NS	12.49**
Urban Girls	Overweight	420.00	53.11	57.89	80.22	91.11	266.67	38.00	189.11	33.22	230.56
	Normal	396.67	48.50	79.17	91.50	101.17	200.00	31.16	83.67	28.50	82.83
	t-value	2.69*	NS	2.52*	NS	NS	NS	NS	4.65**	NS	7.45**
Urban Boys	Overweight	403.33	54.11	35.00	89.11	86.11	208.09	34.67	144.44	36.22	272.89
	Normal	370.00	40.17	65.83	83.67	99.83	253..33	26.17	90.50	23.17	69.67
	t-value	NS	NS	2.55*	NS	NS	NS	NS	5.33**	NS	9.45**

NS – Not Significant, * Significant at 5 percent level, ** Significant at 1 percent level

4.3.5 Nutritional Adequacy

Macronutrient Intake of micro sample

In order to find the intake of energy yielding nutrients in the food consumed by the subjects, analysis of the macronutrients in the food was also carried out. The macronutrient intake of the micro sample was determined from the analysis of food sample collected during weighment survey and the results are given in Table 20 and 21. Table 18 and 19 indicated that energy rich foods were being frequently used by all groups of children. As illustrated in the tables, the carbohydrate, fat and protein intake of the micro sample showed a significant difference in overweight and normal weight children of both 10-12 and 13-15 age groups irrespective of the area wise difference. The intake was lower for normal weight children of all the groups, but when compared with RDA the required allowance was met in both groups. And the intake was relatively much higher among the overweight groups.

Table 20. Comparison of macronutrient intake between 10-12 years old overweight and normal weight boys and girls of rural and urban areas.

	Group	CHO (gms)	Fat (gms)	Protein (gms)
			22 $_{RDA}$	54-57 $_{RDA}$
Rural Girls	Overweight	338	58	69
	Normal	310	47	54
	t-value	3.53**	4.26**	3.84*
Rural Boys	Overweight	359	61	78
	Normal	295	45	55
	t-value	8.01**	6.71**	6.10**
Urban Girls	Overweight	335	61	76
	Normal	292	45	58
	t-value	4.77**	6.30**	4.27**
Urban Boys	Overweight	352	71	87
	Normal	322	51	62
	t-value	5.31**	5.73**	7.80**

* Significant at 5% level, ** Significant at 1% level: $_{RDA}$-Recommended Dietary Allowance

As revealed in Table 16, 17, 18 and 19 showing the food use frequency, food preference and quantity analysis of the food, all proved the fact that the consumption of cereals, fats and oils, sugar, meat group, and fast foods were higher in overweight children of both age groups than that of normal weight children. Comparison of the quantity of the food intake with RDA also revealed a dearth in the intake of all the food

groups except cereals, fats and oils, sugar, meat group and fast foods which were higher than the RDA. This was reflected in their macronutrient intake (Table 20 and 21) with highly significant difference in the intake of carbohydrate, protein and fat between overweight and normal weight boys and girls of both rural and urban areas.

When area wise difference in macronutrient intake was observed in 10-12 year old boys and girls, it was found that the intake of carbohydrates was higher among the rural children and the fat and protein intake was higher among urban children. The same pattern of intake was observed in both boys and girls of this age group.

Table 21. Comparison of macronutrient intake between 13-15 years old overweight and normal weight boys and girls of rural and urban areas.

	Group	CHO (gms)	Fat (gms)	Protein (gms)
			22 RDA	65-70 RDA
Rural Girls	Overweight	408	80	96
	Normal	323	50	60
	t-value	4.26**	4.87**	4.95**
Rural Boys	Overweight	421	884	102
	Normal	327	49	57
	t-value	6.45**	6.33**	6.56**
Urban Girls	Overweight	425	89	100
	Normal	333	52	62
	t-value	5.40**	6.08**	7.36**
Urban Boys	Overweight	428	93	109
	Normal	364	56	71
	t-value	3.27**	7.90**	8.39**

* Significant at 5% level, ** Significant at 1% level: RDA-Recommended Dietary Allowance

When the area wise difference in macronutrient intake of 13-15 year old children were noticed, it was found that the intake of all the macronutrients viz. carbohydrates, protein and fat were higher in urban children than rural children irrespective of sex wise difference. The intake of macronutrients by overweight boys was higher than that of girls in both age groups irrespective of the area wise difference.

Micronutrient Intake of micro sample

Even though excess intake of macronutrients is the major contributing factor in the development of overweight, a closer look at the micronutrient intake of the subjects was also carried out from their daily dietary pattern using food composition tables (Table 22 and 23). In contrary to the macronutrient intake which was much higher than the

RDA for all the overweight children, micronutrient intake was not meeting the RDA requirements in all cases. The calcium intake met the RDA for all the 10-12 year old overweight and normal weight children except for normal weight rural and urban girls.

Table 22. Comparison of micronutrient intake in 10-12 year old overweight and normal weight children

Group	Calcium (mg)	Iron (mg)	Carotene ug	Thiamine (mg)	Niacin (mg)	Riboflavin (mg)	Vitamin C (mg)
RDA	600 g/d	34 mg(b) 19 mg(g)	2400 ug/d	1.1 mg -b 1.0 mg -g	15 mg- b 13 mg -g	1.3 mg (b) 1.2 mg (g)	40 mg/d
RuralGirls							
Overweight	657	15.30	3955	1.20	19.01	1.50	43
Normal	505	12.58	2405	1.05	14.30	1.12	41
RuralBoys							
Overweight	674	16.40	3998	1.31	17.70	1.53	42
Normal	692	19.40	3302	1.21	14.23	1.52	40
UrbanGirls							
Overweight	647	15.40	1659	1.10	18.50	1.49	31
Normal	588	15.08	4424	1.07	15.10	1.33	46
UrbanBoys							
Overweight	654	14.30	1448	1.26	18.63	1.46	26
Normal	652	15.00	3415	1.12	13.79	1.40	43

b -boys, g -girls

Table 23. Comparison of micronutrient intake in 13-15 year old overweight and normal weight children

Group	Calcium (mg)	Iron (mg)	Carotene ug	Thiamine (mg)	Niacin (mg)	Riboflavin (mg)	Vitamin C (mg)
RDA	600 g/d	41 mg-b 28 mg-g	2400 ug/d	1.2 mg -b 1.0 mg -g	16 mg(b) 14 mg(g)	1.3 mg (b) 1.2 mg (g)	40 mg/d
RuralGirls							
Overweight	425	19.45	2625	1.50	23.60	1.22	42
Normal	474	18.18	3408	1.32	18.50	1.19	47
RuralBoys							
Overweight	449	18.82	2805	1.44	22.90	1.22	37
Normal	332	19.64	2444	1.31	17.85	1.25	37
UrbanGirls							
Overweight	530	20.60	3943	1.56	24.80	1.43	43
Normal	461	19.36	3547	1.36	18.05	1.12	50
UrbanBoys							
Overweight	454	18.78	2583	1.45	21.70	1.22	36
Normal	498	16.94	2463	1.31	16.91	1.25	38

b -boys, g -girls

However, in 13-15 year old children calcium intake did not meet the RDA in any groups. Intake of B-complex vitamins like thiamine, riboflavin and niacin met the RDA in overweight as well as normal weight children of both age groups. Overweight children had higher intake of B-complex vitamins than normal weight children. Vitamin C intake and Vitamin/Carotene also met the RDA requirements in both overweight and normal weight children except that of overweight urban boys and girls of 10-12 year age group. Iron intake was found to be the lowest in both overweight and normal weight children of the two age groups and the RDA requirements were also not met by any of the groups. Thus, unlike the macronutrient intake, micronutrient intake of both overweight and normal weight children were found to be inadequate when compared with the RDA.

4.4 Time Utilization Pattern and Activity Pattern

In order to assess the activity pattern and energy expenditure of the subjects, the time utilization pattern and time spent for each activity per day was analysed.

As described in methodology, the subjects were asked to prepare a 24 hour time log of their activities per day for a week. These activities were grouped as sedentary, moderate heavy and sleep. Sedentary activities included rest and leisure time activities like television watching, movies, listening to music and other light activities. Under moderate activities included studying, walking moderately fast, other activities done while standing that requires moderate arm movement. Heavy activities included exercise, walking fast, hand washing large articles, dancing, hanging out clothes, sweeping, cleaning, mopping etc.

The average time spent by overweight and normal children for each type of activity was statistically analysed using Analysis of variance and the results are given in Table 24. As illustrated in Table 24, there existed a highly significant difference in the activity pattern of overweight and normal weight children. The difference in sleep hours of overweight and normal weight children was not very different except that for urban girls where normal weight urban girls slept more. Sedentary activities were significantly higher in rural and urban overweight children. The time spent for moderate activity by normal weight children was significantly higher in all the groups except that of urban girls. In all the four groups, the time spent for heavy activities by normal weight children

were much higher and the difference was statistically significant at 1 per cent level when compared to their overweight counterparts.

Table 24. Comparison of time expenditure pattern between overweight and normal weight boys and girls of rural and urban areas.

	Sleep (hrs)	Sedentary((hrs)	Moderate (hrs)	Heavy (hrs)
Rural Girls				
Overweight	7.59	11.46	4.40	0.55
Normal	7.66	8.44	4.87	3.03
F-value	NS	142.35**	4.14**	360.42**
Rural Boys				
Overweight	7.15	12.40	3.78	0.67
Normal	7.60	8.80	5.17	2.43
F-value	NS	206.65**	37.21**	142.23**
Urban Girls				
Overweight	7.38	11.38	4.59	0.65
Normal	7.90	8.55	4.75	2.8
F-value	6.45**	248.48**	NS	269.47**
Urban Boys				
Overweight	8.00	13.45	2.16	0.39
Normal	7.93	9.40	3.94	2.73
F-value	NS	341.14**	156.59**	501.29**

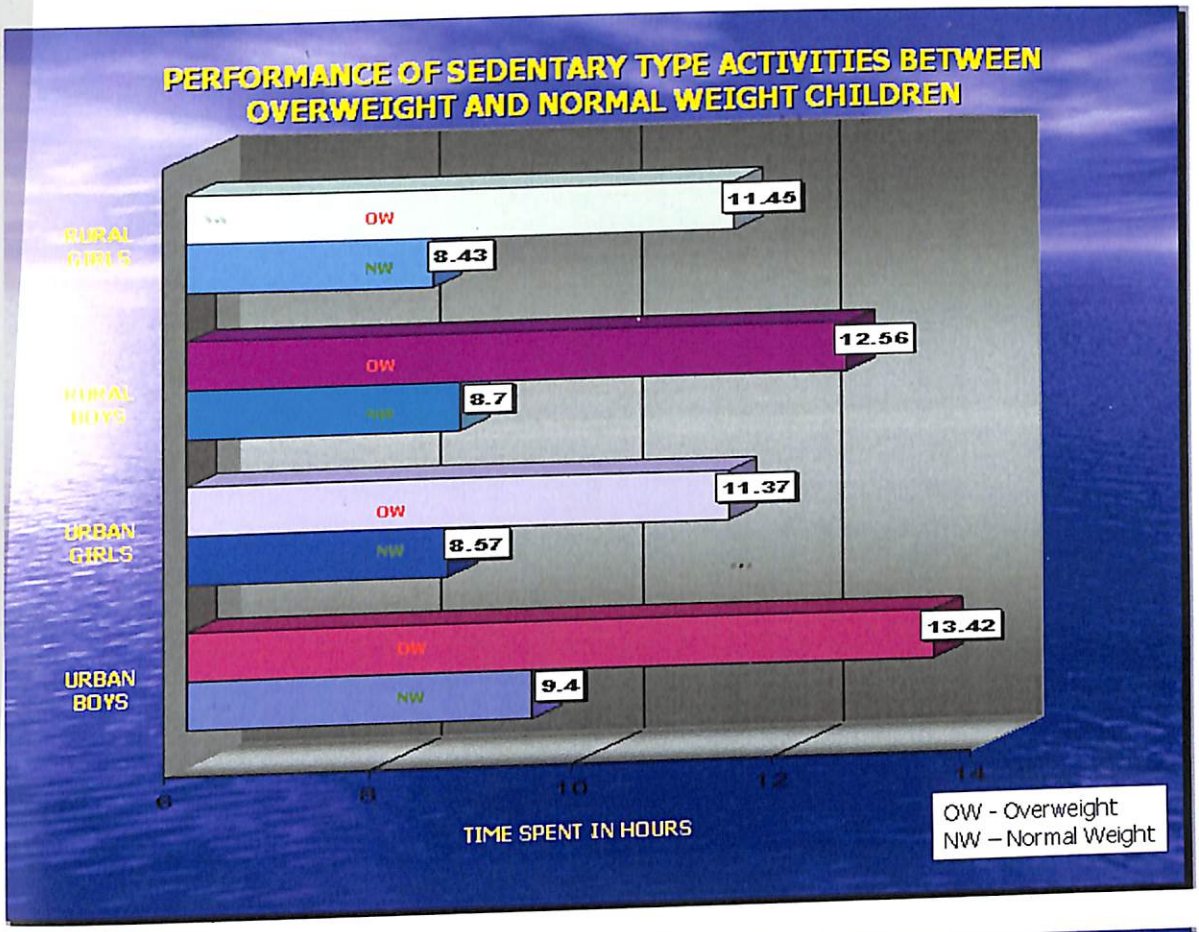
* Significant at 5% level, ** Significant at 1% level

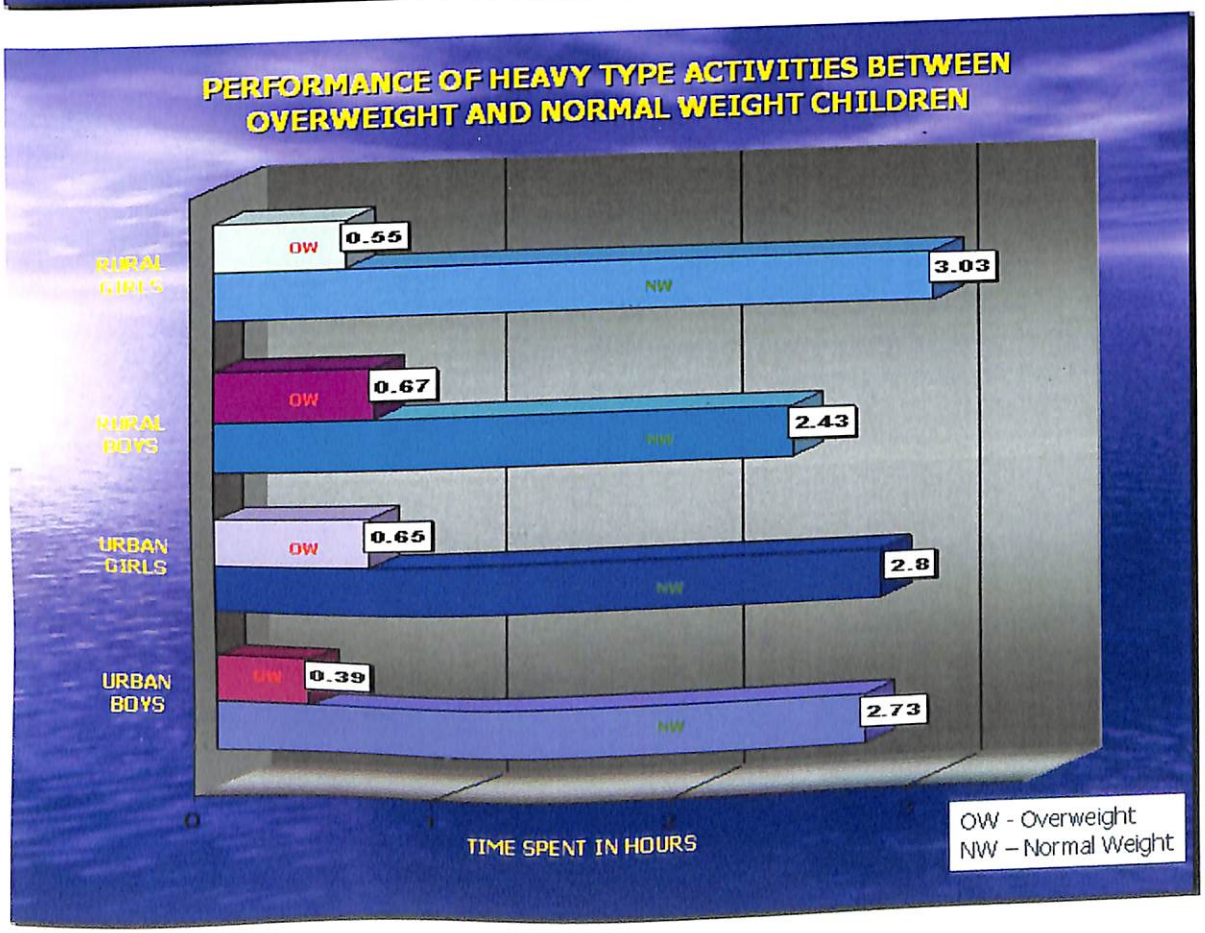
Table 25. Comparison of activity pattern among overweight boys and girls of rural and urban areas

Activity	Rural Boys	Urban Boys	**F value**	Rural Girls	Urban Girls	**F value**
Sleep (hrs)	7.00	8.00	86.01**	7.59	7.38	4.05*
Sedentary(hrs)	12.56	13.48	40.77**	11.45	11.38	NS
Moderate(hrs)	3.78	2.13	263.9**	4.41	4.59	NS
Heavy(hrs)	0.660	0.390	16.96**	0.55	0.65	NS

* Significant at 5% level, ** Significant at 1% level

It can be noted from Table 25 that the area wise difference in activity pattern of overweight boys was also statistically significant at 1 percent level with urban overweight boys spending more time for sleep and sedentary activities while rural overweight boys


PERFORMANCE OF SEDENTARY TYPE ACTIVITIES BETWEEN OVERWEIGHT AND NORMAL WEIGHT CHILDREN
RURAL GIRLS
OW
NW
11.45
8.43
RURAL BOYS
OW
NW
12.56
8.7
URBAN GIRLS
OW
NW
11.37
8.57
URBAN BOYS
OW
NW
13.42
9.4
6
8
10
12
14
TIME SPENT IN HOURS
OW - Overweight
NW – Normal Weight


PERFORMANCE OF HEAVY TYPE ACTIVITIES BETWEEN OVERWEIGHT AND NORMAL WEIGHT CHILDREN
RURAL GIRLS
OW
NW
0.55
3.03
RURAL BOYS
OW
NW
0.67
2.43
URBAN GIRLS
OW
NW
0.65
2.8
URBAN BOYS
OW
NW
0.39
2.73
0
1
2
TIME SPENT IN HOURS
OW - Overweight
NW – Normal Weight

were spending more time for moderate and heavy activities. However, in the case of girls there was only negligible difference between rural and urban girls except in the case of sleep. In general, it was found that overweight children spent more time in sedentary activities and the amount of time spent by normal weight children in energy demanding activities like walking, active games, sports etc. were significantly higher than of overweight children. Moreover the results indicated that the activity pattern rural and urban overweight boys were significantly different.

4.5 Assessment of Energy Balance Based on Energy Intake and Energy Expenditure

As there was significant difference between the food consumption and activity pattern of overweight and normal weight children, energy balance study was also carried out to find out the difference in energy balance between these two groups. For assuring the accuracy of the study, energy balance was done only on the micro sample.

Energy balance was determined from the energy intake and energy expenditure of the micro sample. Energy intake was computed from the actual food intake using food composition tables (NIN, 1999). The average energy expenditure for a week was assessed for the micro sample using an activity time log. The total energy expenditure was estimated from the calorie needed for basal metabolism (corrected for saving in sleep) and energy required for different types of activities. The energy intake, energy expenditure and energy balance of the micro sample is given in Table 26 and 27.

As indicated in Table 26 and 27, there existed a significant difference in the energy intake and energy balance of rural and urban overweight and normal weight children in 10-12 and 13-15 age groups. Even though higher energy expenditure was seen among normal weight children than overweight children, the difference was found to be insignificant.

The energy balance was found to be positive in all the groups irrespective of weight, area and sex status. The difference in energy balance was found to be highest in overweight and normal weight urban boys of 10-12 and 13-15 age groups with significant t values at 1 per cent level, where as this difference was slightly lower for 10-12 year old overweight and normal weight urban girls revealing a significant difference at 5 per cent level.

Table 26. Comparison of energy expenditure, energy intake and energy balance between 10- 12 year old overweight and normal boys and girls of rural and urban areas.

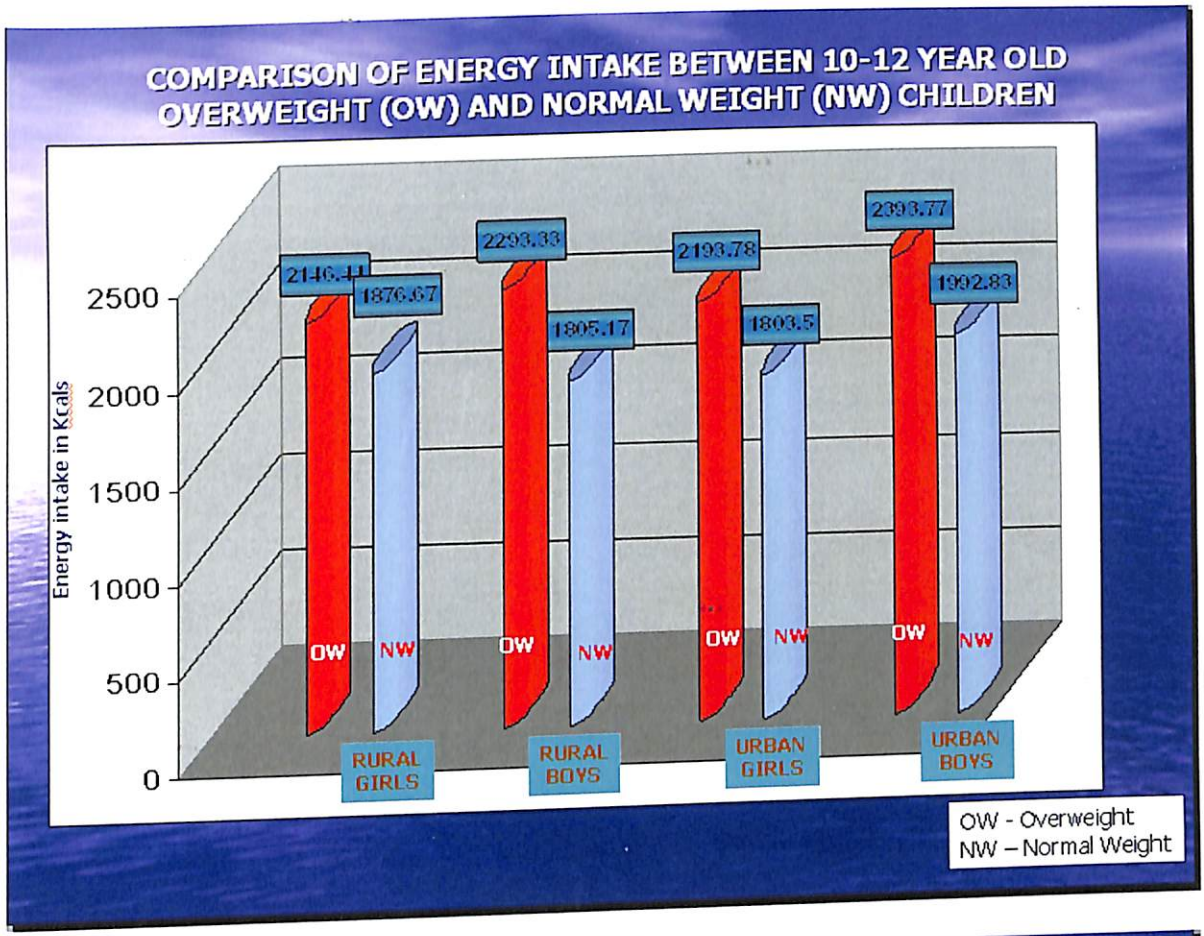
	Group	Energy Intake (Kcal)	Energy Expenditure (Kcal)	Energy Balance (Kcal)	Energy RDA (Kcal)
Rural Girls	Overweight	2146	1311	836	1970
	Normal	1877	1394	483	
	t-value	5.07**	NS	3.24**	
Rural Boys	Overweight	2293	1345	948	2190
	Normal	1805	1361	445	
	t-value	8.43**	NS	3.46**	
Urban Girls	Overweight	2194	1343	851	1970
	Normal	1804	1294	510	
	t-value	6.29**	NS	2.37*	
Urban Boys	Overweight	2394	1346	1048	2190
	Normal	1994	1523	470	
	t-value	7.72**	NS	5.28**	

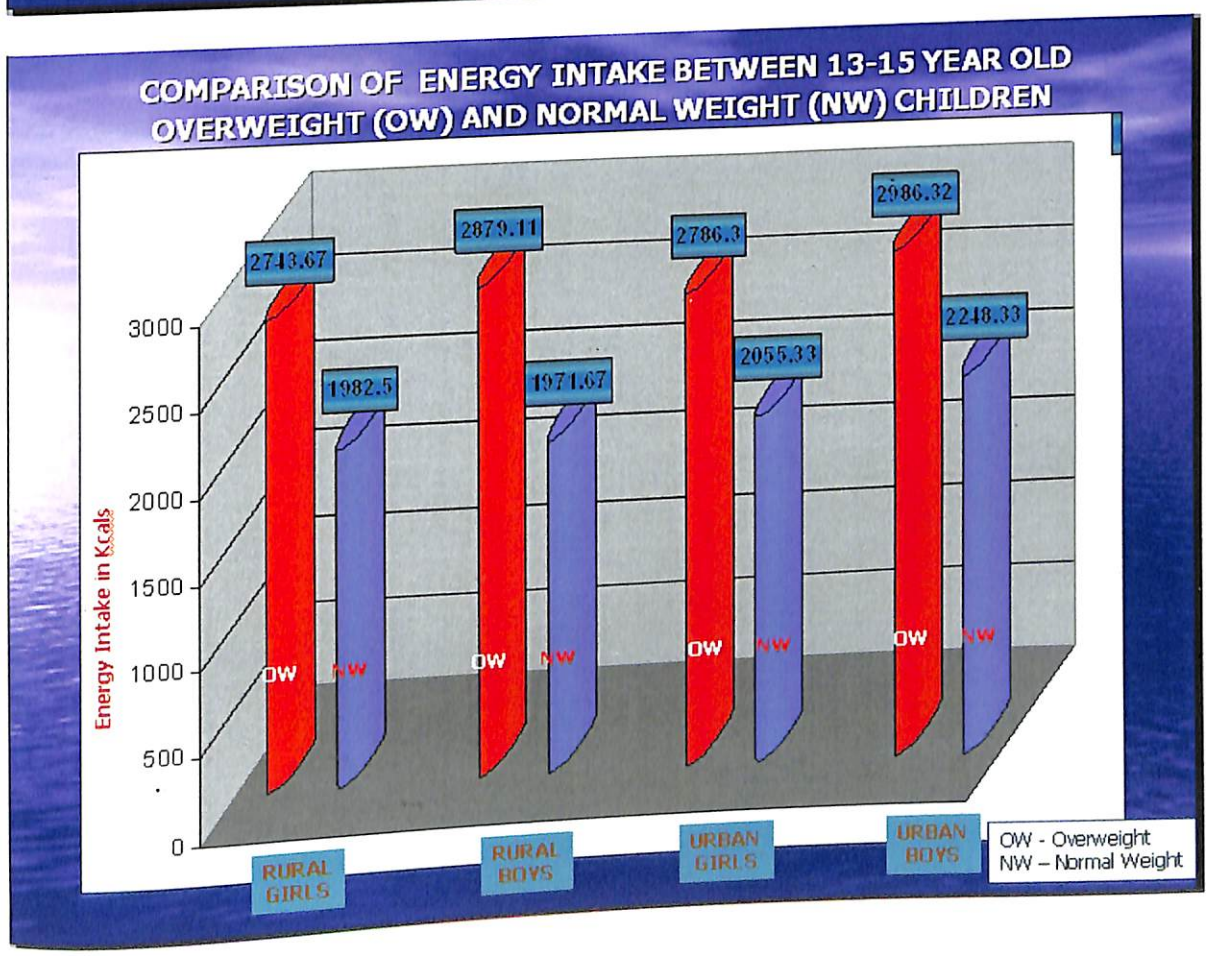
* Significant at 5% level, ** Significant at 1% level, RDA-Recommended Dietary Allowance

Table 27. Comparison of energy expenditure, energy intake and energy balance between 13 -15 year old overweight and normal boys and girls of rural and urban areas.

	Group	Energy Intake (Kcal)	Energy Expenditure (Kcal)	Energy Balance (Kcal)	Energy RDA (Kcal)
Rural Girls	Overweight	2744	1748	996	2060
	Normal	1983	1990	-7	
	t-value	4.80**	NS	5.39**	
Rural Boys	Overweight	2879	2040	840	2450
	Normal	1972	1839	133	
	t-value	6.94**	NS	3.47**	
Urban Girls	Overweight	2786	1880	906	2060
	Normal	2055	1793	262	
	t-value	5.94**	NS	4.78**	
Urban Boys	Overweight	2986	1840	1147	2450
	Normal	2248	2022	227	
	t-value	5.81**	NS	7.84**	

* Significant at 5% level, ** Significant at 1% level, RDA-Recommended Dietary Allowance


COMPARISON OF ENERGY INTAKE BETWEEN 10-12 YEAR OLD OVERWEIGHT (OW) AND NORMAL WEIGHT (NW) CHILDREN
Energy intake in Kcals
2500
2000
1500
1000
500
0
2146.41
1876.67
2293.33
1805.17
2193.78
1803.5
2393.77
1992.83
OW
NW
RURAL GIRLS
RURAL BOYS
URBAN GIRLS
URBAN BOYS
OW - Overweight
NW – Normal Weight


COMPARISON OF ENERGY INTAKE BETWEEN 13-15 YEAR OLD OVERWEIGHT (OW) AND NORMAL WEIGHT (NW) CHILDREN
Energy Intake in Kcals
3000
2500
2000
1500
1000
500
0
2743.67
1982.5
2879.11
1971.67
2786.3
2055.33
2986.32
2248.33
OW
NW
RURAL GIRLS
RURAL BOYS
URBAN GIRLS
URBAN BOYS
OW - Overweight
NW – Normal Weight

When the energy intake was compared with RDA of different age groups, it was found that energy intake of overweight children in all groups have exceeded their RDA whereas for normal weight children it was slightly below the RDA in both age groups.

When the area wise difference in energy balance was analysed, it was found that the positive energy balance was higher among the urban children than rural children of both age groups in overweight as well as normal weight children. The sex wise comparison indicated that the positive energy balance was higher overweight boys than that of girls.

4.6 Assessment of overweight related problems

4.6.1 Pubertal Problems in children

Review of literature revealed that precocious puberty is now being seen in overweight/obese children where the children matures earlier than normal weight children with very early onset of menses, breast development etc. in girls and with appearance of secondary sex characteristics in boys. In precocious puberty children starts developing secondary sex characteristics as early as 5 years of age. Hormonal imbalances and other pubertal problems were also reported to be higher in overweight children. An attempt was made to study the pubertal problems of overweight and normal weight children in the present study and the results are presented in Table 28 and 29.

Table 28 revealed that approximately 52 percent of the overweight rural girls who were old enough to answer questions regarding menarche reported that their onset of menarche was early, and for 36 percent it was at normal pubertal age and for 11.11 percent onset of menarche was late. Out of the 15 normal weight rural girls who responded, all of them reported that they had a normal onset of menarche. Among overweight girls, 33.33 percent had menstrual problems like pain and problems with bleeding etc. whereas only 6.67 percent of the normal weight girls reported the same problem.

Among urban overweight girls, 42.22 percent had early onset of menarche, 42.22 percent had normal onset of menarche and 15.56 percent had late onset of menarche. Among urban normal weight girls, 86.67 percent had normal onset of menarche and 13.33 percent had late menarche. None of the urban normal weight girls had an early

onset of menarche. Similarly, when 42.22 percent of urban overweight girls reported menstrual problems only 13.33 percent of normal weight girls had menstrual problems revealing that overweight has an influence on the onset of menses and the problems related to menstruation.

Table 28. Onset of menarche in overweight and normal weight girls in rural and urban areas.

	Early	Normal	Late age	Menstrual problems	
				Yes	No
Rural Girls					
Overweight	47 (52.00)	33 (36.00)	10 (11.11)	30 (33.33)	60 (66.67)
Normal	-	15 (100.00)	-	1 (6.67)	14 (93.33)
Urban Girls					
Overweight	38 (42.22)	38 (42.22)	14 (15.56)	38 (42.22)	52 (57.78)
Normal	-	13 (86.67)	2 (13.33)	2 (13.33)	13 (86.67)

(Percentages given in parenthesis)

When the problems were studied among boys, it was found that when 23.64 per cent of overweight rural boys had their voice change at an early age, 52.73 per cent had at the normal pubertal age and 23.64 per cent had voice change at a very late age while a higher majority of the normal weight boys (76.47) had their voice change at normal pubertal ages. Among urban overweight boys also, the onset of early and late voice change percentages were higher in overweight children when compared with normal weight children. As depicted in Table 29, a higher percentage of overweight boys in both rural and urban areas reported problems associated with appearance of facial hair at a very early age when compared to the normal weight boys of both areas.

Table 29. Onset of puberty in overweight and normal weight boys in rural and urban area

	Voice change			Appearance of facial hair		
	Early	Normal	Late	Early	Normal	Late
Rural Boys						
Overweight	13 (23.64)	29 (52.73)	13 (23.64)	12 (21.82)	35 (63.64)	8 (14.54)
Normal	0	13 (76.47)	4 (23.53)	1(5.88)	15 (88.23)	1 (5.88)
Urban Boys						
Overweight	14 (18.42)	48 (63.16)	14 (18.42)	11 (14.47)	49 (64.47)	16 (21.05)
Normal	1 (5.88)	14 (82.35)	2 (11.76)	2 (11.76)	13 (76.47)	2 (11.76)

(Percentages given in parenthesis)

4.6.2 Health and Physical problems

The health and physical problems of the subjects were assessed using a check list and the scores were grouped into low medium and high. Scoring was done in such a way that higher scores indicate higher number of problems. General health problems like head ache, body aches, back aches, leg/joint aches, problems with digestion, frequent sickness, problems with appetite, sweating, problems in running, playing, climbing stairs, crossing roads etc and other physical problems were included in the questionnaire. Information regarding chronic health problems like diabetes, hypertension and heart disease etc were also collected. No incidence of diabetes or heart disease was reported in overweight or normal weight children. However, two cases, elevated cholesterol level had been reported by the mothers of two overweight children. The blood pressure of the overweight children was observed to be not much different from that of normal weight children. However the percentage of family members having hypertension, heart disease and diabetes were higher in families of overweight children than normal weight children. It was noted that all of the overweight as well as the normal weight subjects had taken proper immunization. The area wise and sex wise distribution of scores obtained for all the health and physical problems identified in overweight and normal children are given in Table 30.

It was observed that all the normal weight children from the four groups (100 percent) had low scores (<6) and 66.67 to 75 per cent of overweight children from

different groups had low scores indicating lower health and physical problems in overweight children. Approximately one third of the overweight children had medium scores between 6 and 12 indicating higher number of health and physical problems. Only very few children (1-2 %) from the overweight and no child from the normal weight were found in the high score group.

Table 30. Comparison of health and physical problems in over weight and normal weight boys and girls of rural and urban areas

	Low Score < 6	Medium Score 6-12	High Score >12
Rural Girls			
Overweight	130 (72.22)	50 (27.78)	-
Normal	30 (100.00)	-	-
Rural Boys			
Overweight	120 (66.67)	59 (32.78)	1 (0.55)
Normal	30 (100.00)	-	-
Urban Girls			
Overweight	121 (67.22)	57 (31.67)	2 (1.11)
Normal	30 (100.00)	-	-
Urban Boys			
Overweight	135 (75.00)	45 (25.00)	1 (0.55)
Normal	30 (100.00)	-	-

(Percentages given in parenthesis)

4.6.3 Academic/Psychosocial and Behavioral Adjustment Problems

The problems the children faced in relation to their physical status, their attitude and behaviour towards family members, and also the emotional problems, social problems, academic problems and problems with values and adjustments were assessed using a five point scale. The scoring was done in such a way that the child with maximum problems will get the lowest score and the child with minimum problems will get the highest score. The data obtained were scored, added and Analysis of variance was carried out to see if the differences in scores of normal and overweight children were statistically significant and to see if an area wise, sex wise and age wise difference existed among overweight children.

For comparison, the children were grouped into four namely rural girls, urban girls, rural boys and urban boys. As illustrated in Table 31, the scores obtained by the overweight children are very low compared to that of their normal weight counterparts

indicating more psychosocial problems in overweight children. To confirm the difference statistically, Analysis of variance was done and the results showed that the difference in scores were statistically significant in all the areas studied between overweight and normal weight children except in one case. In the case of values and adjustment the differences between urban boys were negligible. The table indicated that social problems and problems with self perception had the highest difference among overweight and normal weight children of all the four groups followed by problems with attitude and behaviour in family.

Emotional problems and academic problems were also significantly different between overweight groups and normal weight groups. Though significant, problems in values and adjustment had the lowest difference between overweight and normal weight children compared to other problems. Among urban boys, the problems in values and adjustment between overweight and normal weight children were found to be not significant. Thus the results indicated that overweight children had more problems in all areas than normal weight children

Table 31. Comparison of psychosocial problems in overweight and normal weight children in rural and urban areas

	Physical Perception Problems of self	Problems with attitude and behaviour in family	Emotional problems	Social Problems	Academic Problems	Problems with values and adjustment
Rural Girls						
Overweight	60.29	60.63	63.12	52.37	62.69	63.29
Normal	70.50	67.90	69.07	64.43	68.87	67.23
F value	50.50**	54.56**	13.13**	117.16**	14.61**	6.9**
Urban Girls						
Overweight	62.10	59.64	64.48	53.37	61.97	65.37
Normal	72.10	67.90	71.53	64.27	71.33	67.73
F value	69.20**	40.51**	21.34**	63.54**	30.93**	3.89*
Rural Boys						
Overweight	59.52	60.21	64.16	55.99	61.44	64.67
Normal	70.63	67.87	70.13	63.93	68.43	67.87
F value	81.95**	34.44**	13.90**	27.05**	17.12**	6.41**
Urban Boys						
Overweight	59.74	61.60	64.69	54.11	63.00	65.86
Normal	70.03	68.97	71.17	64.30	69.83	67.73
F value	53.53**	42.65**	21.48**	66.61**	18.05**	NS (2.62)

* Significant at 5% level, ** Significant at 1% level

Analysis of variance was also done to find out the area wise and age wise difference in problems of overweight children and the results are given in Table 32. As per the results of statistical analysis, the area wise (or rural and urban) difference in the scores of overweight boys and girls were found to be not significant revealing that the area has no specific influence on their problems. But when the influence of age on psychosocial problems was studied it was found to be significant in both overweight boys and girls indicating that along with obesity, age is also a factor which leads to many of the psychosocial problems among the children studied. The problems increased with age and reached highest at 13 years in girls and 14 years in boys except rural boys. Then the problems seem to decrease.

Table 32. Area wise and age wise comparison of psychosocial problems in overweight boys and girls

Age	Overweight Girls			Overweight Boys		
	Rural	Urban	Total	Rural	Urban	Total
10	399.20	393.20	396.20	406.60	390.20	398.40
11	405.20	416.40	410.80	400.00	414.80	407.40
12	413.60	405.80	409.70	412.80	419.20	416.00
13	423.40	436.00	429.70	424.20	415.60	419.90
14	406.00	421.00	413.50	419.60	421.00	420.30
15	400.60	416.80	408.70	390.00	411.40	400.70
Total	408.00	414.87		408.87	412.03	
Comparison:	F	CD		F		CD
Rural Vs Urban:		NS				NS
Between ages :	4.02**	6.08		3.18**		6.13
Age Vs. Place:		NS		NS		NS

* Significant at 5% level, ** Significant at 1% level, CD: Critical difference at 5 % level

4.7 Assessment of Knowledge, Attitude and Practices

Sources of information of the subjects regarding nutrition, health, food and weight reduction were collected. Ninety three per cent of the overweight and normal weight children reported that they got information regarding food, weight reduction etc from their mothers, family members, teachers and friends. For the rest of the subjects, media and printed materials had contributed to be the source of information.

The review of literature revealed a relationship between the nutritional knowledge/cognition, attitude, practices and weight gain. In order to test this, the data

regarding the nutritional Knowledge, Attitude and Practices of the subjects were collected and analysed.

Knowledge, Attitude and Practices of the subjects were analysed using an Obesity Related -Knowledge Attitude Practices (OR-KAP) scale. Each of the Knowledge, Attitude and Practices scale is comprised of three sections. Questions regarding nutrition and balanced diet form the first section, diet and diet related diseases form the second section and physical activity and weight reduction form the third section.

4.7.1 Knowledge Regarding Nutrition, Balanced diet, Diet related diseases, physical activity and weight reduction

The data collected using the OR-KAP scale were scored and the scores of the three sections were added and Analysis of Variance was carried out to find out the variations in score between overweight and normal weight children. The range of the Knowledge scores was from 0 to120 with 120 being the maximum possible score and 0 being the minimum. The knowledge of the subjects were mainly tested on nutrition, balanced diet, diet related diseases, the role of physical activity in weight reduction and weight maintenance. As illustrated in Table 33 the mean scores of rural and urban normal weight children in knowledge was much higher than that of overweight children in all the four groups and the difference was also found to be statistically significant at 1 per cent level.

As illustrated in Table 34 the area wise Analysis of variance in rural and urban overweight girls indicate that the rural and urban difference in knowledge scores among them was statistically significant at 5 per cent level (F = 3.89*). Similarly, the age wise difference in overweight girls was also found to be statistically significant at 1 per cent level (F= 9.56**). Among overweight boys also, it was found that the rural and urban difference and the age wise difference in knowledge scores were found to be highly statistically significant.

Table 33. Comparison of mean scores of Knowledge, Attitude and Practices in overweight and normal weight boys and girls of rural and urban areas.

	Knowledge	Attitude	Practices
Rural Girls			
Overweight	68.99	103.40	95.09
Normal	79.97	107.33	101.60
F value	121.90**	5.47**	16.76**
Urban Girls			
Overweight	67.84	102.77	95.32
Normal	80.20	105.63	101.70
F value	87.47**	1.81 (NS)	15.47**
Rural Boys			
Overweight	69.29	103.33	93.38
Normal	81.47	107.40	99.77
F value	85.18**	3.68 (NS)	14.34**
Urban Boys			
Overweight	74.57	109.88	90.47
Normal	83.73	113.40	98.60
F value	44.97**	3.14 (NS)	17.46**

* Significant at 5% level, ** Significant at 1% level

Table 34. Area wise and age wise comparison of Knowledge scores of overweight boys and girls

Age	Overweight Girls			Overweight Boys		
	Rural	Urban	Total	Rural	Urban	Total
10	66.40	64.27	65.33	64.77	72.23	68.5
11	68.13	65.03	65.58	68.90	72.70	70.80
12	69.23	67.03	68.13	69.57	72.40	70.98
13	69.80	68.67	69.23	68.30	73.97	71.13
14	69.43	70.23	69.83	72.23	77.57	74.90
15	70.90	71.80	71.36	72.00	78.50	75.27
Total						
Comparison:	F	CD		F		CD
Rural Vs Urban:	3.89**	1.25		5.65**		1.51
Between ages :	9.56**	1.98		9.33**		2.38
Age Vs. Place:	NS			NS		

*Significant at 5% level, ** Significant at 1% level, CD: Critical difference at 5 % level

4.7.2 Attitude Regarding Nutrition, Balanced diet, Diet related diseases, physical activity and weight reduction

The subjects' attitude towards nutrition, balanced diet, diet related diseases, physical activity and weight reduction were assessed using a three point attitude scale. The minimum score given to each question was 1 and maximum score 3. Thus the maximum possible score for total three sections of the attitude scale was 144 and the minimum score was 48 with 48 questions in the three sections of the attitude scale. The attitude of the subjects were mainly assessed on nutrition, balanced diet, diet related diseases, the role of physical activity in weight reduction and weight maintenance. The data obtained were scored and Analysis of variance was carried out to see if the differences in scores of normal and overweight children were statistically significant and to see if an area wise and age wise difference existed among overweight children.

I t can be noted from Table 33 the attitude scores for normal weight children were higher than that of overweight children in each age group indicating more right attitudes in normal weight children. However ANOVA results indicated that the differences in attitude scores were insignificant between overweight and normal weight children except for rural girls where the difference was significant at 5 per cent level..

Table 35. Area wise and age wise comparison of Attitude scores of overweight boys and girls

Age	Overweight Girls			Overweight Boys		
	Rural	Urban	Total	Rural	Urban	Total
10	112.40	103.40	107.90	101.80	109.60	105.70
11	105.00	101.40	103.20	109.00	112.40	110.70
12	109.40	105.20	107.30	110.00	110.60	110.30
13	104.80	106.60	105.70	106.20	118.60	112.40
14	108.60	108.60	108.60	109.80	117.60	113.70
15	105.40	108.60	107.00	107.60	111.60	109.60
Total	107.60	105.63		107.40	113.40	
Comparison:	F	CD		F		CD
Rural Vs Urban:		NS		11.58**		2.44
Between ages :		NS				NS
Age Vs. Place:		NS				NS

*Significant at 5% level, ** Significant at 1% level, CD: Critical difference at 5 % level

Table 35 revealed that there is no significant difference between rural and urban overweight girls of any given age in their attitudes. But in the case of rural and urban overweight boys significant difference at 1 per cent level was noted.

4.7.3 Practices Related to Nutrition, Balanced diet, Diet related diseases, physical activity and weight reduction

The subjects' practices related to nutrition, diet related diseases, physical activity and weight reduction were assessed using a three point scale. The minimum score given to each question was 1 and maximum score 3. Thus the maximum possible score for total three sections of the attitude scale was 117 and the minimum score was 39 with 39 questions in the three sections of the attitude scale. The practices of the subjects were mainly assessed on nutrition, balanced diet, management of diet related diseases, daily physical activity pattern and weight reduction methods. The data obtained were scored and totaled and Analysis of variance was carried out to see if the differences between normal and overweight children are statistically significant and to see whether area and age wise difference existed among overweight children.

As can be seen from Table 33, the difference in practices between overweight and normal weight children were highly significant with normal weight children having higher scores. Analysis of variance indicated a significant difference in scores of all the four groups of normal and overweight boys and girls revealing more right practices among normal weight children than overweight children.

It can also be seen from Table 36 that the area wise difference in the practices of overweight boys was significant at 1 per cent level with an F value of 8.7**. When between the age difference in scores were not significant in overweight boys, the influence of age and place on the scores was significant at 1 per cent level with F value 4.09**.

Among girls also, the area wise difference in practices was significant at 1 per cent level with an F value of 5.63**. However, the age wise differences and the influence of age and place on practices were found to be not significant. The results suggested that among girls and boys, rural children revealed a better score depicting more right practices than urban children.

Table 36. Area wise and age wise comparison of Practices in overweight boys and girls

Age	Overweight Girls			Overweight Boys		
	Rural	Urban	Total	Rural	Urban	Total
10	97.80	93.53	95.67	84.00	91.00	88.00
11	95.60	93.56	94.58	95.37	89.67	92.52
12	96.27	93.63	94.58	95.17	90.57	92.87
13	97.57	96.50	97.05	94.26	92.70	93.48
14	97.77	96.63	97.20	95.50	89.77	92.63
15	98.50	98.07	98.28	88.90	95.17	92.03
Total	97.25	95.32		93.38	90.47	
Comparison:	F	CD		F		CD
Rural Vs Urban:	5.63**	1.74		8.7**		2.11
Between ages :		NS				NS
Age Vs. Place:		NS		4.09**		1.02

* Significant at 5% level, ** Significant at 1% level, CD: Critical difference at 5 % level

4.8 Impact of Diet Counselling and Health education

The overweight children and mothers who were cooperative, highly motivated and fully willing to comply with the dietary guidelines and to undergo lifestyle changes to induce weight reduction were selected as the micro sample.

Diet counselling and health education along with nutrition education leaflet and booklet, sample diet/menu pattern for weight reduction (Appendix-X) and follow up counselling sessions were given to overweight micro sample and their parents. The impact of these on body weight and body fat was assessed by taking anthropometric measurements, body fat at the end of six months and the results are compared with normal weight children and presented in Table 37. The change in nutritional knowledge and attitude on weight reduction; physical activity etc was also assessed after six months.

Although height was not a parameter in the assessment, height was also taken each time along with other anthropometric measurements. The difference in height was found to be not significant before and after counselling in any of the four groups of overweight and normal weight children. As illustrated in the Table 37, there existed a highly significant weight reduction at 1 percent level among all the four groups of overweight children after counselling, with highest significant difference in urban boys with a t value of 6.93**. But not much difference was seen in the weights of normal weight children.

Table.37 Comparison of the Impact of diet counselling and health education on weight, BMI and body fat of overweight and normal weight children

Impact of diet counselling on body weight in overweight and normal children				
	Group	Weight (kg) Before	Weight (kg) After	Paired t-test
Rural Girls	Overweight	56.75	54.14	5.34**
	Normal	46.13	46.00	NS
Rural Boys	Overweight	62.14	59.31	5.18**
	Normal	46.79	46.30	NS
Urban Girls	Overweight	59.69	57.14	5.85**
	Normal	43.79	43.79	NS
Urban Boys	Overweight	69.36	65.83	6.93**
	Normal	51.95	51.50	NS
Impact of diet counselling on Body Mass Index (BMI)				
	Group	BMI Before	BMI After	Paired t-test
Rural Girls	Overweight	24.37	23.12	6.22**
	Normal	20.44	20.22	NS
Rural Boys	Overweight	26.05	24.70	6.89**
	Normal	20.18	20.09	NS
Urban Girls	Overweight	25.56	24.33	6.98**
	Normal	19.66	19.58	NS
Urban Boys	Overweight	27.54	26.01	9.17**
	Normal	20.04	19.93	NS
Impact of diet counselling on Body fat (%) in overweight and normal children				
	Group	Body fat (%) Before	Body fat (%) After	Paired t-test
Rural Girls	Overweight	32.33	30.57	3.07**
	Normal	23.43	23.05	NS
Rural Boys	Overweight	30.08	28.68	4.29**
	Normal	16.82	16.48	NS
Urban Girls	Overweight	33.45	31.62	3.98**
	Normal	21.65	21.41	NS
Urban Boys	Overweight	32.66	26.52	10.09**
	Normal	16.93	16.73	NS

Similarly the reduction in Body Mass Index (BMI) was also significant at 1 per cent level in all the four overweight groups with highest significant reduction in urban boys with a t value of 9.17**.

Among the normal weight group, the BMI reduction after six months was not significant. Comparisons were also made on the body fat percentages of overweight

children before and after diet counselling/at the end of 6 months. It was found that all the four groups of overweight children had statistically significant reduction in their body fat with t values 3.07**, 4.29**, 3.98** and 10.09** in rural girls, rural boys, urban girls and urban boys respectively. The body fat reduction was found to be highest among urban boys. However, the body fat reduction in normal weight groups was rather very little and the difference was not at all significant.

The scores for nutritional knowledge, attitude and practices were higher at the end of the six months. Overweight children also claimed to be engaging in physical activities like cycling, walking and other physically active games. However, statistical analysis revealed no significant difference in these two set of scores.

4.9 Interrelationship between variables selected for the study

As the obese children revealed a significant difference from the normal weight children in many of the variables studied, correlation was done to find out the relationship of different variables with obesity.

The results of the analysis of inter-relationship of different variables selected for the present study are given in Table 38 and 39.

The data was statistically treated to find out if there was any significant relationship with the different variables selected for the study viz., the anthropometric measurements, knowledge attitude and practices towards nutrition, diet related diseases, physical activity and weight reduction and psychosocial adjustment problems of the overweight children.

The interrelationships of different variables in overweight boys were as follows. Body Mass Index (BMI) is a factor of height and weight as it is calculated by dividing weight in kilograms by height in meters squared. Therefore as expected, height and weight had significant correlation at 1 percent level with BMI (0.51) in overweight boys. Waist circumference (0.56) and body fat percentage (0.46) also had high positive correlation with height in overweight boys. Similarly, BMI also was highly related to body fat (0.54), waist circumference (0.43) and weight (0.70) with 1 percent level significance. Mid Upper Arm Circumference was related to height (0.32) and weight (0.26) with 1 percent level of significance and with BMI (0.20) and waist circumference (0.22) with 5 percent level of significance. Waist circumference was highly correlated

with body fat (0.43), weight (0.63) and knowledge level (0.24) of the subjects at 1 percent level and with waist hip ratio (0.19) at 5 percent level. Similarly the body fat percentage of the overweight boys was highly related with their weight (0.59) and with their knowledge at 5 percent level. A significant correlation at 1 percent level (0.25) was also noted between the weight and knowledge of overweight boys.

Similarly, when considering their activity pattern, sleep was found to have a high negative correlation (-0.49) with their moderate activity. The sedentary activity of the overweight boys also had a negative correlation at 1 percent level with their moderate and heavy activities.

The moderate activity pattern of the overweight boys had significant negative correlation at 5 percent level (-0.22) with their attitude towards nutrition, diet related diseases, physical activity and weight reduction. The knowledge of the subjects in the above mentioned areas was also found have a high positive correlation with their attitudes (0.27) and practices (0.30) in the same topics. Similarly attitude of the subjects in nutrition, physical activity, weight normalcy also had a significant positive correlation at 1 percent level (0.31) with their practices.

Interrelationship among different variables was also studied in overweight girls. As with overweight boys, height was found to be significantly related at 1 percent level with weight (0.89), and BMI (0.47) in overweight girls. Similarly waist circumference (0.46) and body fat percentage (0.34) were also had high positive correlation with height in overweight girls. Height also was related with the knowledge of the overweight girls in nutrition, diet related diseases, physical activity and weight reduction. Also BMI was highly related to body fat (0.75) and weight (0.82) and waist circumference (0.40) with 1 percent level significance. Mid Upper Arm Circumference was related to height (0.25) and weight (0.30), BMI (0.28) and waist circumference with 1 percent level significance. Waist circumference was highly correlated with body fat (0.33), weight (0.51), waist hip ratio (0.44) and knowledge level (0.27) of the overweight girls. The body fat percentage of the overweight girls was highly correlated with their weight (0.62). A significant correlation at 5 percent level (0.19) was also noted between the weight and knowledge of overweight girls.

Similarly, when considering their activity pattern, sleep was found to have a high negative correlation with the sedentary (-0.21) and moderate activity (-0.56). The sedentary activity of the overweight girls also had a negative correlation at 1 percent level with their moderate (-0.55) and heavy activities (-0.40).

The knowledge of the subjects towards nutrition, diet related diseases, physical activity and weight reduction was also found have a high positive correlation with their practices (0.25) in the same topics.

Even though, there was a statistically significant difference at 1 percent level noted in the physical, health, psychosocial and behavioural adjustment problems of overweight and normal weight children, when the interrelationship between these problems were analysed a significant correlation could not be found. Therefore, as proposed an index explaining the association of these problems in overweight children could not be developed. Instead an index based on the contributing factors of overweight and obesity was developed.

Table 38. Interrelationship of different variables selected for the study in overweight boys

		MUAC	Height	BMI	WC	Body fat	Weight	Sleep	Sedentary	Moderate	Knowledge	Attitude
1	MUAC	1										
2	Height	0.321**	1									
3	BMI	0.204*	0.511**	1								
4	WC	0.227*	0.556**	0.432**	1							
5	Bodyfat	0.153	0.460**	0.540**	0.433**	1						
6	Weight	0.267**	0.875**	0.699**	0.628**	0.588**	1					
7	WHR	0.017	-0.132	0.0078	0.196	0.070	-0.139					
8	Sleep	0.085	0.001	-0.0846	0.012	0.012	-0.004	1				
9	Sedentary	-0.055	0.019	-0.0015	0.043	0.062	0.027	-0.119	1			
10	Moderate	-0.024	-0.005	0.005	-0.071	-0.102	-0.024	-0.490**	-0.60**	1		
11	Heavy	-0.003	-0.047	0.057	-0.032	-0.031	-0.034	-0.167	-0.593**	0.169		
12	Knowledge	0.074	0.270**	0.149	0.240*	0.221*	0.250**	0.116	0.088	-0.185	1	
13	Attitude	0.048	0.135	-0.003	0.142	0.074	0.116	0.177	0.136	-0.222*	0.272**	1
14	Practices	-0.047	0.115	0.115	-0.004	0.054	0.121	-0.064	-0.108	0.129	0.306**	0.312**

- Significant at 5 per cent level, ** Significant at 1 per cent level

Table 39. Interrelationship of different variables selected for the study in overweight girls

S.No		MUAC	height	BMI	WC	Body fat	weight	knowledge	attitude
1	MUAC	1							
2	Height	0.250**	1						
3	BMI	0.276**	0.469**	1					
4	WC	0.301**	0.463**	0.403**	1				
5	Bodyfat	0.185	0.342**	0.750**	0.329**	1			
6	Weight	0.305*	0.885**	0.821**	0.507**	0.618**	1		
7	WHR	-0.109	-0.030	-0.055	0.438**	0.030	-0.047		
8	Sleep	0.082	-0.026	-0.041	0.018	-0.037	-0.040		
9	Sedentary	-0.027	-0.001	0.025	-0.054	-0.015	0.011		
10	Moderate	-0.078	0.034	0.031	0.041	0.078	0.037		
11	Heavy	0.068	-0.020	-0.040	-0.013	-0.063	-0.029		
12	Knowledge	0.054	0.206*	0.106	0.274**	0.071	0.191*	1	
13	Attitude	0.030	0.097	0.151	0.103	0.133	0.139	-0.163	1
14	Practices	0.020	0.084	0.043	0.131	0.031	0.077	0.250**	0.156

* Significant at 5 per cent level, ** Significant at 1 per cent level

Development of Index to distinguish between overweight/obese and normal weight children

A discriminating index based on Fishers Discriminant Functions was worked out based on the data obtained for micro sample to distinguish between normal weight and overweight children. Based on the interrelationship among the various characters studied, the following variables namely age, height, BMI, Body fat, MUAC, energy intake and energy balance were identified for developing the index. In the case of male children the index developed was = -3.52 AGE + 0.60 HT + 3.22 BMI + 0.60 MAC + 4.97 BF + 0.23 EI + 5.22 EB.

In the case of overweight/obese children, the index values ranged from 1698.43 to 9498.49. The mean score obtained here was 6044.21 and the standard error obtained for the mean was 277.43.

In the case of normal weight children, the index values ranged from 227 to 4666.75. Minor overlap may be due to the sampling fluctuations or differences in the selected sample. The mean score of the normal weight children was 2129.94 and the standard error was 252.16.

In the case of female children, I = -4.54AGE + 3.06 HT + 2.12 BMI – 2.68 MAC + 4.27 BF + 1.93 EI + 2.64 EB. For obese female children the values ranged from 5799.49 to 10496.80. The mean score obtained here was 7624.20 and the standard error of the mean was found to be 207.67. In the case of normal weight female children, the values ranged from 3797.75 to 6536.43. The mean score of normal weight female children is 5508.96 and the standard error was 126.42.

5. DISCUSSION

The results presented in the previous chapter are discussed in this section with relevant empirical evidence.

5.1 Prevalence of overweight and obesity among rural and urban school children in Thiruvananthapuram educational district

5.2 Comparison of anthropometric measurements between rural and urban overweight and normal weight children

5.3 Obesogenic Environmental Factors and Familial characteristics of the subjects

5.4 Dietary Profile of the subjects

5.4.1 Dietary Adequacy of the subjects

5.5 Time Utilization and Activity Pattern of the subjects

5.6 Energy Balance from energy intake and energy expenditure of the subjects

5.7 Assessment of overweight related problems in subjects

5.8 Nutritional knowledge, attitude and practices of the subjects

5.9 Diet counseling and Impact of Health Education on overweight children

5.10 Interrelationship between variables selected for the study

We live in an energy sparing society today. Changes in diet coupled with inactive life styles have sparked off overweight and obesity in several countries around the world. Childhood obesity, a risk factor for adult obesity is an increasing global concern today. Overweight and obesity during childhood is a matter of growing concern in India also. Several reports show an increasing rate of overweight and obesity in the developed countries but the extent of the problem in developing countries still remains unknown. There are only a few studies done on the prevalence and contributing factors of childhood obesity in India especially Kerala.

The present study therefore attempts to understand the contributing factors and problems associated with overweight among rural and urban school children of 10-15 years of age. Information regarding the contributing factors and related problems were collected using standard procedures from the study sample including overweight and normal weight children selected from rural and urban schools of Thiruvananthapuram

educational district. The results obtained from the analysis of the pooled data are discussed in detail here.

5.1 Prevalence of overweight and obesity among school children in Thiruvananthapuram educational district

During the screening and selection of sample for the study, the following observations were made on the prevalence of overweight and obesity in school going children of Thiruvananthauram educational District.

Children between 10-15 years of age from nine schools were screened to select 120 overweight children from each age group including 60 boys and 60 girls. From the total of 3886 children screened, the overall prevalence of childhood obesity was found to be 4.99 percent and overweight prevalence was 17.73 percent when only 58.67 percent was normal weight, 16.16 percent were underweight and 2.44 percent were severely underweight with a BMI less than 13. An interesting observation made was that the overall prevalence of overweight and underweight was more or less equal at about 16 to18 percent. The study thus proved that even though the indicators of over nutrition like overweight and obesity are rising disturbingly, undernutrition is still a problem in India. It is observed that even with all the progress made in health and nutrition, Kerala still has severely undernourished children especially in the rural areas.

The results of the present study revealed that overweight and obesity in children in our country are gradually growing like other developed and developing countries of the world. In a study conducted in Delhi by Kapil et al.(2002) where the overall prevalence of obesity was 7.4 percent in children from affluent families and in another obesity study done by Ramnath (2002) in 1500 school children of Meerut UP, prevalence was 9 percent.

When compared to the prevalence studies done before two decades or more in Kerala, the rate of underweight is reducing while that of overweight and obesity is increasing. Studies done by Ramachandran (2002) in 1000 adolescent children of Thiruvananthapuram, Kerala and Geetha (2003) on high school girls of Thiruvananthapuram revealed 5.4 percent and 2.2 percent of obesity respectively. Studies reveal that in India, Kerala is not the only state facing the problem of overweight and obesity; it is also growing in other states as can be seen from these studies.

Yet another study by Popkin (2003) in all the five metros of Delhi, Mumbai, Chennai, Hyderabad and Kolkata it had been noticed that one out of every five school children or 20 percent are overweight.

The results of the present study are consistent with the reports of Chatterjee (2002). In a study done by Nutrition Foundation of India (NFI) among 5000 children aged 4 -18 years from a Delhi private school, 29 percent of were found to be overweight. In the present study also the overall prevalence of over nutrition i.e., obesity and overweight among rural and urban children was found to be 22.72 percent indicating that Kerala is also under the spell of increase in the prevalence of overweight and obesity like other metropolitan cities.

While obesity seems to be growing in children regardless of sex, it can be noted that there is a sex wise variation in the prevalence of overweight and obesity in children irrespective of the area as revealed in many studies done in India and abroad. The present study also compared the sex wise variation seen in children. Studies by Kapil et al.(2002), indicated that the prevalence of obesity was lower in girls (6%) as compared to boys (8%). On the contrary, studies done by Mudur (2003) and Marwaha et al.(2006) in three major Indian cities found that more girls were overweight and obese than boys. Contradictory results were obtained in the present study where the prevalence of overweight and obesity among boys was found to be higher than that of girls. When the prevalence of obesity was 3.9 percent in girls of 10-15 years age, prevalence in boys was noticed to be 5.99 percent. Similarly the overweight prevalence in girls was 16.45 percent, whereas that in boys was 18.80. All these studies therefore indicate that the sex of the child has an influence on the prevalence of overweight and obesity.

Review of literature on obesity revealed another important fact that the area or place of residence of the child also has an influence on obesity. In the present study, the prevalence of overweight and obesity was found to be higher and significant in urban boys and girls compared to rural boys and girls. The overweight prevalence in urban boys was found to be 21.31 percent whereas that in rural boys was only 8.31 percent where the difference was significant at 1 percent level. Similarly when the prevalence of overweight was 20.90 percent among urban girls it was only 11.92 percent in rural girls. This difference was also significant at 1 percent level. School surveys done by Mudur

(2003) in Indian cities have also showed that 30 percent of the adolescents from India's higher economic groups were overweight, and 14 percent of them were from urban schools. Bhave et al. (2004) found in his study that at least 1 in every 10 urban middle class children was overweight. In the present study prevalence of obesity was also noted to be significantly higher in urban boys (6.73%) compared to (2.93%) in rural boys. Similarly, obesity in urban girls was higher than that in rural girls with significant difference at 1 percent level. Gross and Monterio (1989) also had reported that overweight and obesity was more prevalent in urban population, particularly among higher socioeconomic groups.

According to the present study among 1769 girls from rural and urban areas, 20.23 percent of them were found to be either overweight or obese. A concurrent study by Geetha (2003) in Trivandrum had found that among 3000 high school girls of the district, 7.5 percent were either overweight or obese.

Another factor that seems to have an influence on obesity is the age of the child. In the present study also it was observed that obesity and overweight prevalence vary with age. The results revealed that among rural girls, the prevalence of obesity was highest in 12 year olds and lowest in 15 year olds and among urban girls, the prevalence of obesity was highest obesity was highest at the age of 13 and lowest at the age of 14.

Similarly among rural boys, 13 year olds had the highest prevalence of obesity (4.11%) and the lowest was seen among 14 year olds (1.11%). Among urban boys 12 year olds (7.45%) have the highest obesity prevalence whereas the lowest was seen in 15 year olds (1.17%). A significant point brought out by the study by Grewal et al.(2006) in Delhi schools which is in agreement with the present study is the fact that overweight and obesity start manifesting as early as 5 years of age.

When compared to obesity, the incidence of overweight in children was significantly higher in both rural and urban areas. Amid rural girls, overweight was highest in 15 year olds (18.99%) and lowest in 10 year olds (5.39%). In urban girls, the highest overweight prevalence (31.80%) was seen in 13 year olds and lowest was seen in 12 year olds at 9.3 percent.

Likewise in rural boys, overweight was highest in 10 year olds (11.11%) and lowest in 15 year olds (5.12%). Among urban boys, 13 year olds had the highest overweight (23.40%) and the lowest was seen in 10 and 14 year olds (20.40%).

It was interesting to note that overweight in urban areas was highest in 13 year old boys and girls. Among rural children an inverse pattern was observed in the prevalence between boys and girls i.e., when the overweight incidence was highest in 15 year old and lowest in 10 year old rural girls, among rural boys 15 year olds have the lowest prevalence and 10 year old have the highest prevalence. However the results confers that a sex wise variation is seen in overweight/obesity pattern.

5.2 Comparison of anthropometric measurements between rural and urban overweight and normal weight children

The assessment of overweight and obesity in children was done by measuring the anthropometric measurements like BMI and body fat percentage. According to Rao (1996) nutritional anthropometry can be used to understand whether a person is underweight, normal weight, overweight or obese. Obesity can also be assessed by total body weight, estimation of total body fat and also by skin fold measurements (Swaminathan, 2005). In this study, these obesity assessment techniques were further used to confirm the overweight or obesity in children screened from different schools. As expected, the anthropometric measurements of overweight and normal weight children observed to be different with overweight children having higher values not only for weight, BMI and body fat, but also in waist circumferences, waist hip ratio and mid arm circumferences. The mean height of the overweight rural and urban girls was revealed to be 149.38 and 150.34 respectively. Similarly, the mean height of overweight rural and urban boys was 155.23 and 155.34 respectively. Since height alone is not an indicator of overweight, the difference in mean height of the overweight children was not significantly different from that of normal weight children in both rural and urban areas.

According to Elizabeth (2007), overweight is defined as relative weight up to 20 percent above normal and obesity is defined as relative weight 20 percent above ideal body weight. The mean weight of the overweight urban girls (56.23)) was noted to be slightly higher than of overweight rural girls. However, among overweight boys, the mean weight of rural children (61.43) was slightly higher than urban children (61.29). As

expected a significant difference at 1 per cent level was observed between the weight of overweight and normal weight children in both rural and urban areas.

Reports by WHO (1998) pointed that BMI is a good indicator of nutritional status which can be used to screen both overweight and obesity. Here in this study, standardized IOTF cut off values reported by Cole et al. (2000) for growing children were used to screen for overweight and obesity. When the mean BMI of overweight rural and urban girls were compared, urban girls (24.65%) were found to have higher BMI compared to their rural counterparts (23.97%). Similarly, the mean BMI's of urban boys (25.29%) were higher than rural boys (25.12%). A significant difference at 1 per cent level was also observed in the BMI of overweight and normal weight children in rural as well as urban areas.

The best way to estimate body fat and body composition is to use bioelectrical impedance (Elizabeth, 2007). According to Dwyer and Blizzard (1996) the cut off value for obesity was 30-32 percent fat in girls and 20-25 percent fat in boys. The mean body fat percentage in overweight/obese urban girls (32.82) and urban boys (25.66) was higher than that of rural girls (30.05) and rural boys (25.13) respectively. When comparing the body fat percentage, a highly significant difference was noted in overweight/obese and normal weight groups of rural girls (30.05 & 24.33), urban girls (32.82 & 24.57), rural boys (25.13 & 19.88) and urban boys(25.66 & 17.57).

Waist circumference is another highly sensitive and specific measure of central obesity. Cut off values for risk is 102 cm in adult males, 88cm in adult females and 71 cm in prepubertal children (Higgins et al. 2001). In the present study the waist circumference of the overweight boys were noted to be higher in both rural and urban areas compared to overweight girls. Also the mean waist circumference of overweight boys and girls were significantly higher when compared to that of normal weight children in both rural and urban areas.

According to Anita and Abraham (2006), the normal waist: hip ratio is 0.7; a person with upper body obesity has a ratio of 0.85 or higher. The mean WHR (Waist: Hip Ratio) of overweight urban boys (0.92) and girls (0.88) in the study were higher than that of rural boys (0.90) and girls (0.88). The WHR of overweight children was noted to be significantly higher than that of normal weight children of all the four groups.

MUAC is also another measurement that helps to assess the amount of subcutaneous fat which in turn gives an indication of calorie reserves in the body of an individual (Malina et al., 1974). As with other measurements, the MUAC of overweight children were significantly higher than that of normal weight children in all the four groups of rural and urban boys and girls though this method is not usually used for assessing overweight and obesity in children. Thus it could be noted that along with higher BMI and body fat, overweight children had higher values than normal weight children in all the anthropometric measurements studied like waist circumference, waist hip ratio, mid upper arm circumference etc.

5.3 Obesogenic Environmental Factors and Familial Characteristics

A glance at the review of literature reveals that overweight and obesity is mostly a creation of the environment even though heredity also plays an important role. Hence attempts were made to assess the obesogenic environmental factors that lead to overweight and obesity in children. The socioeconomic and demographic background of the selected children, their familial environment and their personal characteristics that can lead to overweight and obesity were studied. Besides these familial and socio economic features, the food habits, food consumption pattern, physical activity pattern etc were also studied in detail.

In the present study attempts were done to find out the socioeconomic and demographic profile of the selected children to see if there was any variation existed in these areas between overweight and normal weight children.

5.3.1 Demographic Profile

As mentioned, attempts were made to highlight the socio-demographic profile of the children and their relationship with the weight status. Knowledge of the demographic and socioeconomic features of the school going children is vital for understanding the contributing factors towards overweight or obesity. A recent research reveals that socioeconomic and demographic factors play an important role in the food consumption pattern (Rahman and Rao, 2001). Other studies done earlier also indicate that the effect of nutrition can be understood only in terms of family and social environment and also by the kind of economic and educational resources available for the children (Riccuiti, 1993). Moreover, the assessment of the demographic and socio-

economic environment of the children is critical in getting a vivid picture of the background of the targeted population.

The socio demographic and familial parameters adopted in the study comprised of the sex, age, religion, caste and family details like family size, family type education and employment status of the family, income level and its distribution, housing, domestic condition and infrastructure of the family etc. which might help in understanding the homogeneity and diversity in the socio-demographic factors of the sample. Hence information on these lines was also collected both from overweight and normal weight children.

It could be observed with regard to religion and caste that in majority of the groups the percentages of Hindus were higher. This agrees with earlier findings that Hindus constitute 57 percent of the population of rural Kerala (Kannan et al., 1997). It can also be observed that most of the Muslims in this study were from rural area. This may be because two Muslim schools were part of the study where the population of Muslim children was higher. In urban areas, next to Hindus, Christians had the majority. The caste wise distribution showed that majority in urban areas belonged to forward castes while the majority in rural areas belonged to backward castes. The percentage of Scheduled Caste was the lowest in all groups, where as none of the overweight or normal weight children belonged to Scheduled Tribes. This suggests that religion or caste may not have any influence on the weight gain of the children. Statistical analysis also revealed no association between religion, caste and weight status of the children.

However, since the sample with overweight and obesity were preferably selected for the study, the correlation of obesity in one religion in rural and another religion in urban could be an area that needs further study. i.e., the trend seen in the study was that obesity was more prevalent in Hindus in urban areas and Muslims in rural areas. Another indication is that in caste wise distribution, when the forward caste children had more obesity in urban areas, backward caste children revealed more obesity in the rural area. A comprehensive study on a larger sample from different religion, caste and area is essential to find the underlying causes of this trend.

5.3.2 Familial Characteristics

The familial backgrounds of the subjects were also studied in detail to understand the socio-economic conditions and other obesogenic factors contributing to overweight and obesity. Concerning the family type, about 82 percent of the subjects belonged to nuclear family and the rest 18 percent came from joint families where the children were staying with their parents and grandparents among all the different groups studied. None of the children in the present study belonged to extended families. It was observed from quite a number of earlier studies that the concept of nuclear family is becoming more and more common in our society and joint family system is fast disappearing from the society. The present study also revealed the same. Similar reports were given by Ranganath (1996), Razeena (2000) and Roopa (2003) in their studies done in Thiruvananthapuram district. Statistical analysis revealed an association between family type and weight status of the children. From a close scrutiny it could be noted that the propensity towards overweight is seen more in nuclear families than joint families. This may be because of the increased availability of food items as there are only a few members for sharing food items in a nuclear family. Moreover, eating outside and fast food consumption habits are also more common in members of nuclear families.

In the present study majority (70 per cent) belonged to small sized families with 1 to 4 members comprising of father, mother and one or two children. When the rest 21 per cent belonged to medium sized families with 5-6 members, only 9 per cent came from large sized families with 7 or more members. Regarding the family size, Park (1997) had also reported that average family size in India is four. The results revealed an association between overweight and family size among urban children indicating that family size has an influence on the weight status of the children. Overweight was noticed to be comparatively lower in large and medium sized families compared to small families. This may be because when the number of people in a family decreases, the quality of life increases and there is more money to spend on each person for food and other luxuries.

Interestingly, majority of the overweight children were either first born or last born and the majority of the normal weight children were middle born. This is in line with the previous study done by Chandran (2001) in which the sample selected from Thiruvananthapuram district consisted mainly of first borns from small and nuclear

families with one or two children indicated an association of overweight and obesity with sibling constellation, ordinal position, family size etc. This may be because of the extra attention and pampering given to the first born and last born by their parents. This is also another area which needs further research.

Irrespective of the weight status, majority of the children had only one sibling. Number of siblings seems to have a profound influence on the weight of the children. Overweight children were mostly from families with two children and the number of overweight children reduced as the number of siblings in the family increased. This showed that overweight is inversely proportional to the number of children in the family, i.e number of children in the family has a significant influence on the overweight in children. This again confirms the fact that overweight and obesity is in small nuclear families with one or two children.

One school of thought is that obesity is hereditary and a genetic history of obesity in family can lead to obesity in children. The results of the present study were also in line with the previous findings. Among the children studied, an average of 80 percent overweight children had at least one member in the family including father, mother, sibling or any of the four grand parents either overweight or obese. In normal weight children the percentage of familial overweight or obesity was considerably lower. Statistical analysis also revealed a strong association between overweight/obesity in children and family history of obesity. Robert et al.(1997) had also reported that the risk of adult obesity was greater at any age in both obese and non-obese children if at least one parent was obese. Parental obesity is identified in India as one of the reasons of childhood obesity. A study done by Ramachandran (2002) in Thiruvananthapuram district had also pointed out that obesity in children was found to be clearly parental and sibling obesity. Thus the results confirm the fact that parental obesity or family history of obesity could be a contributing factor towards the development of overweight/obesity in children. Hence children with such family history should be made alert from birth onwards and parents should be prompted to be cautious from birth of their children on how to prevent complications in the future. This may be again because of the extra feeding given to low birth weight or preterm babies as the parental way to add on weight to such babies. Parents have to become aware of the deleterious effects of overfeeding

and should understand the importance of giving a balanced and nutrient dense diet for their babies.

5.3.3 Personal Characteristics

Another interesting observation is that irrespective of the current weight status, majority of the children had birth weights higher than 2.5 kg. However, contradictory to our expectations, the percentage of low birth weight overweight children was more than that of normal weight children. According to a study by Levin and Govek (1998), a direct relation was observed between maternal obesity, infant birth weight and obesity later in life. In the present study birth weight do not seem to have an influence on the overweight condition of the children as chi square revealed no significant association between the two groups. However, an interesting indication is that overweight children were noted to have comparatively lower birth weights than normal weight children. Unlike normal weight children, overweight children have gained excess weight after birth and during their childhood years. Similarly, majority of the children were born as full term babies, however the percentage of overweight children born as preterm babies was noted to be slightly higher than that of normal weight children. However, no association could be seen between weight status and prenatal maturity.

When the duration of breast feeding to the subjects was assessed, majority or an average of 57 percent among different groups was breast fed for more than one year irrespective of weight status. Approximately 90 percent of the overweight and normal weight subjects were breast fed for more than 6 months. This agrees with the so called Kerala model, where the infant or child mortality is reduced admiringly due to the adaptation of healthy practices like small family system, long term breast feeding and natural delivery. Here proper immunization was also given to 100 per cent of the children studied. All the children studied were delivered in hospitals with majority having normal birth weight of 2.5kg or more and 90 percent being breast fed for six months or more. Only less than 10 percent of the babies were premature while majority were born after completing the full term of prenatal period.

5.3.4 Socio-Economic Profile

Education of parents plays an important role in the socioeconomic status of the family. Another observation made in the study was that the level of education of the

parents was relatively high in both overweight and normal weight children. In Kerala with 100 per cent literacy and with every children going to school, this result is not surprising. Irrespective of the weight status of the children it could be noticed that majority of the urban fathers were holding professional degree whereas majority of the urban mothers were having at least a bachelors degree. Among rural boys, majority of the fathers had a professional degree, whereas in rural girls majority of the fathers had education up to pre-degree only. Among rural children, percentage of mothers having pre-degree level education was higher.

As seen in previous studies, majority of the parents of both overweight and normal weight children were reasonably educated in both rural and urban areas with college level education. Hence parental education does not seem to have an influence on the weight of their children. But interestingly, rural children have lower prevalence of overweight compared to urban children and their parents also have lower level of education compared to urban children. But follow up studies needs to be done on a larger sample before coming to any conclusions. This may be due to the difference in the food consumption and activity pattern and life style changes with in rural and urban areas

The employment status of the population is an important determining factor with respect to health and nutritional status as reported by Reddy et al. (2002). According to a study done by Ramachandran (2002), it was found that in the families of overweight children of Trivandrum where both parents are working, there is little time for parents to cook at home and children are used to consume food and fried snacks from out side o.n a regular basis. This can be a reason in the present study too where majority of the parents are employed, particularly mothers. It can be noted that employed mothers were more for overweight children when compared to normal weight children. Another interesting reveal is that majority of the urban fathers of overweight boys and girls were private employees whereas those of normal weight children were Government. employees. Similarly, the fathers of majority of overweight rural boys and girls were noted to be working abroad whereas the majority of fathers of normal weight children were self employed. Similarly most of the mothers of urban overweight children were either working as a private or Government. employees. This is an area which needs further research before coming to conclusions. However it can be assumed that high income

coming from private employment or employment abroad and the lack of time of employed mothers face to cook can change the family food pattern. This could be one of the reasons for the overweight seen children of such families.

Two decades ago itself Grundy (1993) had observed a powerful inverse relationship between obesity and socio economic status in the developed world. According to NFI (2000) nearly one third of the males and more than half of the females belonged to what may be termed the 'upper middle class' in India are currently overweight. The findings of the present study are also consistent with the previous studies. From an observation of the monthly family income of the subjects, it is lucid that majority of the overweight children belonged to the middle income and upper middle income group with family income more than Rs. 5000 whereas majority of the normal weight children belonged to lower middle and middle income group with family income more than Rs.1000. The percentage of overweight children from high income group was more compared to that of normal weight children. On a detailed analysis of the monthly expenditure pattern of the subjects, it was clear that the percentage of income spent by overweight children's family on food was higher than that of normal weight children. When 9.3 percent of overweight children's families spent more than Rs.3000 on food, none of the normal weight children's families spent more than Rs.3000 on food even though the family size is more or less the same. It was noted that the extra spending seen in overweight children's family were on costly fast foods, snacks, restaurant foods and beverages. The increased availability of energy dense food and snacks at home may be the reason for their overweight. The percent of income spent by all families on food was higher compared to all other expenses. This finding is also in concurrence with earlier findings reported by Sarvaekshana (1992) as an average Indian spent more portion of his income for food. The expenditure of normal weight children on housing was noted to be higher than that of overweight children. In all other areas like clothing, healthcare, education, travel, leisure and savings, not much difference was observed among overweight and normal weight children, thus confirming the assumption that the extra money is spent on rich foods which contributes to overweight and obesity.

5.3.5 Quality of Life

When the quality of the housing and other domestic conditions were analysed it was understood that 86.5 percent of the overweight subjects were living in their own houses while only 70 percent of the normal weight children had own houses. When the quality of the infra structure facilities were assessed most of the houses were well built and seems to have required facilities and conveniences in their houses like attached bathrooms, electricity, water and sanitation facilities and vehicles for conveyances in overweight as well as normal weight children. Besides labour saving kitchen appliances, and printed media like newspaper and magazines TV, computer and other electronic equipments were also available in most of the houses. The percentage of overweight children's families having servants (50%) in their houses was higher compared to that of normal weight children's families (38%). This again can contribute to their overweight as help from the servants can considerably reduce the physical activity of the family members.

Sanitation and drinking water facilities are important variables in determining the health status of a population. In the present study, 100 percent of the subjects, irrespective of their weight status had convenient and good quality drinking water facilities and either public or private drainage or sewage facilities. This could be one of the reasons for better health seen in Kerala children and the reduction of underweight.

All these point out that unlike earlier decades, the standard of living of Keralites have improved a lot. Park (1997) had observed that in spite of the income group they are from, a high standard of living is enjoyed by Keralites. Quality of life in the matter of household help was higher for overweight children. This can actually reduce their energy expenditure and can add on to their overweight. But this matter needs further study to make any conclusions.

5.4 Dietary Profile

5.4.1 Food Habits

Social and environmental factors associated with obesity include cultural and family food patterns, job environments, recreational eating that encourage energy dense foods, the social role of eating, the sedentary patterns of recreation and employment, television viewing time with inactivity and constant snacking (Srilakshmi, 1993).

Food habits of an individual are characteristic repetitive act that he performs under the impetus of need to provide himself with nourishment and simultaneously to meet an assortment of social and emotional goals (Gift et al., 1972). Robinson (1998) had opined that dietary habit of an individual in general influences his or her nutritional status. In the present study the food habits, dietary pattern, food preference and food use frequency of the subjects were studied to have an idea on their food consumption pattern. It found from the study that 100 percent of the overweight subjects were non-vegetarians. Among normal weight children, 5 percent were vegetarians and 95 percent were non-vegetarians. Similar result was obtained by Beatrice (1999) in her study undertaken in Thiruvaanthapuram district where majority of adolescent sample were noted as non vegetarians. Consumption pattern of Keralites as reported by Kerala Statistical Institute (2000) also revealed that 98 percent of Keralites are habituated to non vegetarian foods. Hence non vegetarianism cannot be suggested as a reason for overweight.

Questions regarding opinion on dieting revealed that two thirds of the overweight and normal weight boys believed dieting or skipping meals as bad while 50 percent of the rural and urban girls believed that dieting as good regardless of the weight status. Thirty seven percent of the overweight children also responded that they skipped breakfast due to lack of time in the morning because of tuition classes and some children replied that they did not feel hungry when they leave home for school or tuition early in the morning and are usually in a hurry to catch school buses on time. This study is in line with that of Khalil (2003) on breakfast practices where 40 percent of the adolescent children missed breakfast because they don't feel hungry while they are in a hurry to go to classes. The habit of skipping meals was comparatively lesser in normal weight children who took packed lunches and water regularly to school. A few of the older overweight boys also had mentioned that they were ashamed and reluctant to take packed lunches to school as they think going to canteen or bakery with friends is more glamorous and manly. A study by Roopa (2003) also is in agreement with the present findings.

However, ninety five percent of the overweight children had the habit of snacking in between meals especially during holidays and school day evenings. On school days, they resorted to high calorie foods like puffs, pizza, sandwiches, sweet buns, samosas , juices and other carbonated beverages during break time in school. During lunch time

they went to school canteen where mostly items like parathas and chicken fry etc. were served along with bottled juices. As mentioned earlier, the study done by Ramachandran (2002) in Trivandrum had observed the fact that since both parents are working in a good number of families in the District, there is little time for parents to cook at home and children are used to consuming food and snacks from outside on a regular basis. Even though overweight children skip breakfast and refuse packed lunches, they depend on canteen foods and high calorie bakery foods which contribute to their excess weight.

Fifty four percent of normal weight children preferred home made food compared to food made outside or hotel food. On the contrary, 50-65 percent of the overweight children liked both home made and hotel foods. Similarly, the frequency of overweight children eating out was much higher than that of their normal weight counterparts. The use of carbonated beverages and bottled juice were also high among overweight children. It was found from the study that most of the children were found to be leading busy days with tight schedule, tuition classes and irregular meal pattern. Since parents were also busy, they resorted to snacks and other bakery items, canteen foods to fit their tight schedule. In houses of overweight children where mothers were not working, they usually feed their children by making delicious fried and sweet items. Most of the normal weight children were eating home made foods, meals and beverages while majority of the overweight depended on outside food. The foods they consumed from outside were mostly energy dense fried food items and sweets. Thus the increased preference of these energy dense food items by children could be one of the reasons leading to overweight.

On assessing the frequency of use of various food items it was observed that some kind of cereal was consumed daily by both overweight and normal weight children. In addition to this nuts and oil seeds, condiments and spices, fats and edible oil, sugar and jaggery etc were the most perpetually used foods in the dietaries of both overweight and normal weight children of rural and urban areas. Similar results were reported by Mony (1993) Gayathri (2003) and Shiny (2004) as these items were needed in small quantities daily for various culinary preparations popular in this area. A study done on dietary perception and practices in senior secondary boys in Delhi schools also revealed the same that cereals, fats and oil and sugar were consumed daily by adolescents (Vibha and Sibal,

2003). Beverages like either coffee, tea, or complan, bourvita, boost, horlicks etc are consumed daily by both over weight and normal weight children.

Next to cereals, fish, milk and milk products were found to be consumed by both overweight and normal weight children. A study done in Bangladesh among urban adolescent girls revealed that next to cereals which dominated their diet, pulses and fish were the most frequently used food items. (Parveen and Khyrunnisa, 2003). In the present study also it was found that children tend to consume some type of fish item daily along with rice. A similar observation was reported by Karuna (1993) and Nirmala (2002) who also observed that the fish consumption was high in Kerala. The reason may be that the fish is comparatively cheap and abundant in Kerala since it is a coastal state.

Milk was taken daily as such or with tea or coffee. Some children were also consuming milk products like curd, and buttermilk on a regular basis. This study agrees with an earlier study reported by Kavitha (1999) that milk and milk products are included in the daily dietaries of adolescents in Trivandrum district as they have the habit of drinking coffee or tea frequently. A study done in sub-urban Mumbai on food habits, nutritional intake and health of school girls also revealed that two thirds of the students consumed milk or milk products regularly (Raje et al., 2003).

Next to milk, other vegetables, pulses, fruits and fruits were the next highest used in food groups respectively among both overweight and normal weight children with out much difference among the groups. Green leafy vegetables, and roots and tubers had the next priority where the consumption was noted to be much higher in normal weight children compared to overweight children. Mothers who were educated reported that most children were reluctant to consume vegetables as such or vegetable preparations along with rice or chapathi. Mothers also complained that most of the children had the habit of separating the vegetables from curries like sambar and their vegetable consumption is low. Hence, the mothers who were very much aware of the importance of including greens and vegetables in their diet reported that that they cut, mash and grind the vegetables and add to gravies of different preparations with out the knowledge of children. Similar results were obtained in a study done by Roopa (2003) in adolescent children of Trivandrum District. A study reported by Hamulka et al., (2000) also revealed that as the children gets older the frequency of breakfast decreased along with

the consumption of milk and milk products, vegetables and fruits; on the contrary, the intake of fats, sweets, snacks, bakery foods and soft drinks like coca cola increased in adolescence. Hence it is important that the children may be made aware of the importance of eating balanced meals and parents should try to inculcate these good food habits in their children from infancy itself.

The rise in consumption of fast foods in developed and developing nations might have particular relevance to the childhood obesity epidemic (French et al., 2001). According to Gibson (2000) energy density of children's diets are directly associated with not only fat but also a range of starchy foods including breakfast cereal, bread and potatoes. In the present study, the consumption of meat, egg, hotel/canteen foods, fast foods, sweets, snacks and desserts were much higher in overweight children compared to normal weight children. Mothers of overweight children also complained that their children cannot survive with out non-vegetarian food items especially chicken along with daily meals and they also have the habit of constant snacking especially while watching television. Overweight children were noticed to have frequent snacking or nibbling habits especially during evenings, holidays and while watching television. Taras and Gage (1995) had also reported that children tend to passively consume excessive amounts of energy dense foods while watching television. Kapil et al.(2002) also reported that with affluence there is a tendency to enhance the consumption of costly fatty items and oils. Studies by Mudur (2003) also confirmed that there has been a significant increase in the consumption of fats and energy dense foods along with reduction in physical activity.

Food preference is formed as a result of complex interaction of many factors in an individual's environment (Eggert, 1984). Studies by Robson et al., (1991) and Sadana et al., (1997) also indicate that snacks and sweets are highly preferred by adolescent children. In the present study too, the percentage of overweight children who preferred outside food was much higher than that of normal weight children. In the present study overweight children preferred hotel and canteen foods, fast foods, sweets, snacks, desserts, meat and egg more than that of normal weight children. Zoumas et al.(2001) has also observed that family life has changed a lot over the past two decades, with trends towards eating out increasing and also greater access to television than previously. Children consumed more energy when meals are eaten in restaurants than at home,

possibly because restaurants tend to serve larger portions of energy dense foods contributing to childhood overweight and obesity.

French et al. (2001) have also found from their studies that adolescent girls who ate fast foods four times a week consumed 185-260 Kcal per day more were at the risk of becoming overweight. Most of the fast foods typically contains all of the potentially adverse dietary factors including saturated and trans fat, high glycemic index, high energy density and increasingly large portion size. A large fast food meal could contain approximately 2200 Kcal and would require a full marathon to burn off. This is in agreement with the results of the present study where the overweight children consumed more energy dense fast foods frequently which were one of the main contributing factors towards their excess weight.

In short overweight children and normal weight children differ significantly in their food habits and consumption pattern. Unlike normal weight children, the diets of overweight children were dominated by non-vegetarian foods and energy dense foods like fried foods, bakery fast foods, fatty and sweet foods, carbonated beverages and snacks as indicated by their food preference listings. Thus the food preference, frequency and quantity of use of these energy dense food items along with wrong food habits like nibbling habits or frequent snacking habits could be some of the reasons behind the development of overweight in children.

5.4.2 Dietary Pattern and Dietary Adequacy

Monitoring the dietary intake pattern of children is important in order to explore and prevent the onset of adult health problems.

The food preference and consumption score and food intake pattern revealed that the diets of overweight children were comprised mostly of energy dense foods and other sugary and fatty fast foods whereas the consumption was low on vegetables and fruits etc. From a review of the meal pattern of the subjects, it was found that the skipping of breakfast was more common in overweight the children. A good majority of the overweight children were having energy dense foods and beverages from school canteens and nearby bakeries during school breaks. The daily intake of non-vegetarian items was also frequent in overweight children than that of normal weight children. From the menu pattern it was also noticed that milk intake was more common among younger children

than that of older children. Evening tea with energy dense bakery items and fast food items were common in overweight children than that of normal weight children and this was mostly followed by a heavy dinner comprising of items like parotta, chappathi, chicken etc. Vegetable preparations especially green leafy vegetable preparations were very low in the meals of overweight as well as normal weight children

Thus from the food preference and food consumption pattern it was found that the diets of overweight and normal weight children differ significantly. In order to find out the quantitative and qualitative adequacy of the diets further study was done on the microsample. Quantitative information regarding the food consumption pattern of families and the daily dietary intake of the micro sample was assessed from the weighment survey. The dietary adequacy of different food groups were then compared with Recommended Dietary Allowances (RDA) laid out by ICMR (2000).

For comparison of nutritional adequacy, children were grouped into two age groups of 10-12 age group and 13-15 as per ICMR age wise groupings and their intake was compared with RDA. The RDA for the consumption of cereals, fats and oils, meat group and sugar and jaggery was very well met by both overweight and normal weight children. Majority of the subjects being non vegetarians, the intake of protein foods like meat and fish and egg was high. The intake of cereals, fats and oils, meat, fish and egg and sugar by the overweight children were noted to be significantly higher than that of normal weight children in both age groups of rural and urban areas. But there was no sex wise and area wise difference.

The difference noted in the consumption of milk and milk products by overweight and normal weight children was not significant. An interesting observation that was made was RDA for milk was mostly met by 10-12 year old children whereas in older 13-15 year old milk consumption decreased with age and RDA was not met. RDA for fruits and vegetables and green leafy vegetables was not met by either overweight or normal weight children. Consumption of fruits and other vegetables was comparatively higher in normal weight children with no significant age wise, area wise or weight wise difference between different groups. However, for green leafy vegetables, the consumption was significantly lower in overweight urban boys and girls of both age groups. Concurrent results were obtained by Roopa (2003) had revealed that the intake of green leafy

vegetables and fruits were low in the diets of adolescents and school children in Kerala. Thus the results confirm that quantitatively the diets of overweight children met the requirements in carbohydrate, fat and to some extent protein rich foods. But all other food groups the intake was not adequate. These unhealthy food habits can only add on to the weight of the children but not their health.

5.4.3 Nutritional Adequacy

Overweight or obesity could be the result of excess food or energy intake and a positive energy balance. Since the consumption of energy dense food items, cereals and protein rich food items were significantly high in overweight children, the intake of major energy yielding macronutrients were estimated by laboratory analysis in the micro sample to see if there existed any significant difference between overweight and normal weight children. The intake of carbohydrate, fat and protein was found to be significantly higher in overweight children of both age groups irrespective of sex wise and area wise difference. Studies done by Bavedkar et al. (1999) also indicated that traditional micronutrient rich foods in India are being replaced by energy dense highly processed micronutrient poor foods with greatly increased portions contributing to a positive energy balance and consequent weight gain. High calorie snacks, junk food revolution, cool cola colonization, and food as rewards or demonstration of love are part of new life styles. All Indian celebrations or festivals also seem to be centered on rich foods. Concurrent study by Jequier (2001) also acknowledges that fat is the most energy dense macronutrient, the excessive consumption of which is often believed to cause weight gain. When compared to the RDA, the protein and fat intake was much higher in both overweight and normal weight children. Thus it was found out from the study that the macronutrient intake was significantly higher in the case of overweight children when compared with normal weight children.

In contrary to the macronutrient intake which was much higher than the RDA for all the overweight children, micronutrient intake was not meeting the RDA requirements in all cases. The calcium intake met the RDA for the 10-12 year old overweight and normal weight children except for normal weight rural and urban girls. However, in 13-15 year old children calcium intake did not meet the RDA in any groups. Intake of B-complex vitamins like thiamine, riboflavin and niacin met the RDA in overweight as well

as normal weight children of both age groups. Overweight children had higher intake of B-complex vitamins than normal weight children. Vitamin C intake and Vitamin/Carotene also met the RDA requirements in both overweight and normal weight children except that of overweight urban boys and girls of 10-12 year age group. Iron intake was found to be the lowest in both overweight and normal weight children of the two age groups and the RDA requirements were also not met by any of the groups. Thus, unlike the macronutrient intake, micronutrient intake of both overweight and normal weight children were found to be inadequate when compared with the RDA. These inadequacies in micronutrient intake in children are consistent with the studies done by Roopa (2003). Anemia is found to be a common problem of adolescent boys and girls which can lead to many other complications especially in overweight children. Hence modification of their diet incorporating micronutrient rich foods is highly warranted.

5.5 Time Utilization and Activity Pattern

Children all over the world seem to lead a very busy and hectic life today with out much time for rest. The fast changing life style, the hard work and continuous struggle accompanied by physical and mental pressure for achieving their academic and professional goals form the living pattern of today's school going children. This has a profound influence on their health, food habits and eating pattern.

Studies carried out in India and abroad emphasize the fact that the life style and physical activity pattern of the children can make them overweight or obese. For a deeper probe in this area, in the present study the time utilized for different activities by overweight and normal weight were studied for a week. Their activities mainly included studying, going to school, tuition classes, television watching and playing computer games and sleep. These activities were classified to sedentary, moderate and heavy and sleep and the energy expenditure micro sample was then calculated. The energy balance was then computed from total energy intake and energy expenditure.

On a detailed scrutiny of the data on time utilization pattern, it was found that there was no significant difference in the sleep hours of normal weight and overweight children except among urban girls where normal weight children slept more. However, there existed a significant difference in the sedentary activity pattern of overweight and normal weight children where overweight children were spending 3-4 hours more on

sedentary activities like television watching, computer games etc. From the studies of Otis et al.(2004) also, it was found that sedentary pursuits like TV and movie watching, video games, internet gazing and telephone gossip sessions are important activities of Indian children. TV also affects heavy marketing of fatty and sugary foods, or energy dense foods and carbonated beverages. The number of TV sets and telephone connection in the home are also considered as a contributing factor in the development of obesity as children as it displaces physical activity. Robinson (1998) also has reported that television viewing is thought to promote weight gain not only by displacing physical activity, but also by increasing energy intake. Taras and Gage (1995) also has the view that children tend to passively consume excessive amounts of energy dense foods while watching television contributing to weight gain.

As expected moderate activities were found to be higher in all groups of normal weight children and the difference was also found to be significant between overweight and normal weight group except in urban girls. The average time spent by overweight children for moderate activities varied from 2 - 4.59 hours whereas that in normal weight children between 3.93 - 4.87 hours. Concurrent studies by Ramachandran (2002) in overweight children of Trivandrum also asserts that only 12 percent of the children engaged in regular physical activity or outdoor games while 74 percent have no exercise or games at all.

When the time spent by overweight and normal weight children were compared for heavy activities, there also the difference was significantly higher in all groups of normal weight children indicating higher energy expenditure. Time utilized by overweight children for heavy activities varied from 0.39 -0.67 hours whereas that in normal weight group was much higher (2.43 -3.03 hours). Similar studies by Trost et al.(2001) also suggest that obese children in South Carolina spent less time in moderate and vigorous physical activity than their non obese counterparts.

The results of the present study is also in accordance with the studies of Bhave et al.(2004) who reported that an important factor for obesity in India is the intense competition for admissions to schools and colleges with flourishing tuition classes' right from nursery level. Children are forced to use even their play time for additional studies.

Games or physical training sessions are restricted or non existent in many schools. Some schools do not have playgrounds at all. He also reported that due to unsafe roads (traffic, crime) children are discouraged from walking or cycling to school. Motorized vehicles are popular and they are perceived to be quicker and safer for transport. Erosion of open spaces for exercise, inadequate play areas and lack of parental time to supervise play are all part of new obesogenic lifestyles. The same situation is faced by most of the obese or overweight children studied. They either could not play due to heavy burden of studies, busy schedule of extra classes or tuition or could not walk to school due to long distance, heavy traffic etc.

The present study thus confirms the assumption that though the reasons behind a child gaining weight could be many and are varied, lack of physical activity is one of the most common contributing factors.

5.6 Energy Balance

The quantity and quality of food we eat is clearly related to obesity / fat accumulation or leanness in adults as well as in children. Bodyweight is regulated by numerous physiological mechanisms that maintain balance between energy intake and energy expenditure. Any factor that raises energy intake or decreases energy expenditure by even a small amount will cause obesity in the long-term. (Lusting, 2001).

In the present study, energy intake was computed from food /macronutrient intake and energy expenditure was assessed from the time utilization pattern of the subjects for various activities. For comparison, children were grouped to 10-12 and 13-15 years of age as per ICMR age wise classification. As expected, the energy intake of overweight children was found to be significantly higher in both age groups irrespective of area and sex. . On comparison with RDA, all the overweight children had exceeded their energy requirements, while normal weight children had energy intake slightly lower than the RDA.

Although higher energy expenditure values were observed for normal weight children, the difference was not significant. This may be due to the fact that for the calculation of energy expenditure, body weight is a major factor. Even though, the normal weight children were spending more energy for activities, the energy expenditure

difference was not significant because their body weight is lower compared to overweight children.

A positive energy balance was found in all groups of children irrespective of their weight status, area and sex. This can be expected since a positive energy balance is required for the normal growth in children. However, the positive energy balance was significantly higher in overweight children compared to their normal weight counterparts mostly due to their increased energy intake and sedentary life styles. An investigation done by Ukkuru (2002) on the work pattern and food consumption pattern of women in Thiruvananthapuram district also revealed that sedentary activities along with increased energy intake will result in a positive energy balance. The positive energy balance in overweight children ranged from 835 per day to 1048 Kcals per day, whereas that in normal weight children was from 353 to 583 Kcals. It can be observed from the data that after meeting the energy requirements of the day approximately 500 Kcals per day was taken extra by the overweight children. According to Williams (1993) 3500 Kcals is equivalent to 454 gms of body fat weight. So if the children have a positive energy balance of approximately 500 Kcals consecutively for a week, they can gain approximately 0.454 gms of body weight in a week. Any factor that raises energy intake or decreases energy expenditure will cause obesity in the long run (Lusting, 2001). Thus positive energy balance could be another factor leading to overweight in children. In the present study it was also observed that rate of adding on the children were not as much as indicated even in those with a high positive energy balance. This may be due to the fact that higher rate was seen more on preadolescent and adolescent stage when there is a growth spurt in them. Hence the energy needed for growth will also be very high during this period.

Another interesting finding was the negative energy balance seen in rural normal weight girls of 13 to 15 years of age. Although energy intake was much lower for both rural boys and girls of this age, the expenditure was comparatively lower for boys. But from the spending pattern it could be seen that rural girls particularly between 13 to 15 years were engaged in more heavy activities (3.03 hrs per day) and household work compared to other children. These may be the reason for the negative energy balance

seen in them. Also this could be one of the causes for the poor health and lethargy seen in adolescent rural girls in general.

5.7 Assessment of overweight related problems

Research studies suggest that overweight and obesity is associated with a number of problems including health, physical, psychosocial and behavioral adjustment problems. Hence a probe was made into the problems if any faced by the overweight children selected for the study.

5.7.1 Pubertal Problems In Children

The results indicated that some problems were faced by children in all areas of life. The onset of puberty in boys and girls were assessed and it was found that majority of the overweight girls had an early menarche when majority of the normal weight had normal menarche. Menstrual problems are also more in overweight than normal weight girls. The consumption of high fat and high protein diet may be one of the reasons behind this. The availability of hormone injected poultry and beef is increased in Kerala also. Merchants use dried and powdered carcasses as cattle feed and inject hormones for weight gain and growth of poultry and cattle which in turn will be consumed by humans. These hormones can mimic the body estrogen causing early sexual maturity. Since the consumption of meat and meat products are higher in overweight and obese children, they are more susceptible to this estrogen mimics leading to early sexual maturation. Concurrent studies by Koch and Hassemeir (1997) reveal that early sexual development, or precocious puberty in young children, is a growing problem around the world where the exposure to endocrine disruptors and estrogen mimics are high.

Precocious puberty is a phenomenon not only occurring in girls; boys are also experiencing their version of precocious puberty. Twenty three percent of rural and 18.42 percent urban overweight boys had an early voice change and an average of 18 percent had early appearance of facial hair. However, the percentage of normal children having early and late puberty were lesser compared to that of overweight children. Studies also points out the significance and effect of hormone disruptors in the body and their contribution to overweight and obesity and early puberty. A 20-year study found that the greater the prenatal levels of the hormone disruptor polychlorinated biphenyl

(PCBs), the heavier the children were at the age of fourteen and their puberty was earlier Herman-Giddens et al. (2001).

5.7.2 Health and Physical Problems.

The health and physical problems of children were assessed using a check list. The results depicted that 100 percent of normal weight children had lower scores indicating very few health and physical problems. Though the problems in majority of the overweight children were also low, comparatively it was higher than normal weight children. General health problems like head ache, body aches, back aches, leg/joint aches, problems with digestion, frequent sickness, problems with appetite, sweating, running, playing, climbing stairs, crossing roads etc and other physical problems were rated and found to be more in overweight children. Information regarding chronic health problems like diabetes, hypertension and heart disease showed no incidence of diabetes or heart disease reported in overweight or normal weight children. However, two cases, elevated cholesterol level had been reported by the mothers of two overweight children. The blood pressure of the overweight children was observed to be not much different from that of normal weight children. However the percentage family members having hypertension, heart disease and diabetes were higher in families of overweight children than normal weight children. It was also interesting to note that all of the overweight as well as the normal weight subjects had taken proper immunization. High literacy rate and health consciousness among Keralites may be one the reasons for giving priority and importance to timely immunization of their children

5.7.3 Academic/Psychosocial and Behavioural Adjustment problems

In the present study attempts were also made to understand the psychosocial and behavioural adjustment problems of the overweight children. Psychosocial problems in overweight children were analysed to understand the physical perception problems of self, problems with attitude and behaviour in family, emotional problems, social problems, academic problems and problems with values and adjustment. When perception of their physical appearance was compared it was noted to be significantly lower in overweight children compared to that in normal weight children. Overweight children were not satisfied with their appearance and were unhappy in being overweight. They also expressed need or desire to lose weight. Overweight children were also

discontented that most of the times they are not able to fit in beautiful readymade dresses. Generally a low self esteem could be read from the responses of overweight children. Guoss and Chumelea, (1994) had also observed that overweight during adolescence has social, economic and psychological consequences including the effects in high school performance, college acceptance and psychosocial functioning.

The results indicated that the psychosocial problems were comparatively higher in overweight children than normal weight children. Social problems like poor acceptance by peers, inability to make friends, fear/shyness of public speaking/performance, getting teased by peers for being overweight etc were more common in overweight children. Overweight children also showed poor behaviour patterns like unhealthy eating habits, snacking habits and sedentary life style habits at home. Active parental support and encouragement for weight reduction was also not existent for overweight children. Findings of studies by Hill and Silver (1995) also indicated substantial psychosocial consequences of childhood obesity. Obese children were stereotyped as unhealthy, academically unsuccessful, socially inept, unhygienic, and lazy.

The scores for academic problems also indicated more problems among overweight children studied. Disinterest in academic work, lack of energy for studies, difficulty concentrating in class, inability to win prizes, poor academic performance were some of the academic problems reported by overweight children. Related studies done by Gortmaker et al.(1993) have also highlighted the negative social effects of overweight in adolescence. They reported that women who were overweight during adolescence had completed only fewer years of schooling; were less likely to marry and had lower household income. He also observed that overweight men were less likely to get married.

In the present study, overweight children also had higher emotional problems and problems with attitude and behaviour in family compared to normal weight children. Common emotional problems like getting easily hurt, irritability, depression, lack of confidence, frustration were increasingly seen in overweight children. Williams (1993) also had reported that there existed strong prejudice against obese persons, especially directed towards women. The public perceives fat people as having less control over their appetite and as being more responsive to external cues than to internal ones. Majority of the obese people have emotional problems associated with the disease and

the reactive eating caused by stress, anxiety, depression and other emotional problems actually can worsen severity of obesity. In the present study, there was not much difference between the emotional and psychosocial problems of boys and girls, but both expressed problems in these areas.

However in the case of values and adjustment problems, there was not much difference observed between the two groups of overweight and normal weight children. This suggests that even though obese children have more problems in the areas like self perception, attitude and behaviour in family, social, academic and emotional problems; these are not reflected on their moral values and adjustments. That is mostly dependant on the culture and family values in which they are brought up. Since both groups of children are from more or less similar socioeconomic and cultural back ground their values also may not differ much. Unlike western countries, the stable family background with strong family values in Kerala families particularly among middle class is certainly strongly inculcated in their children too. So it can be assumed that problems like overweight cannot have an impact on their moral values. Also, the interaction with their parents in awareness creation classes revealed the genuine interest and strong support given by the parents in helping their children to manage their problems.

5.8 Nutritional Knowledge, Attitude and Practices

Knowledge is a body of understood information possessed by an individual while attitude is what one perceives or how he behaves based on knowledge. While assessing the knowledge of the subjects on nutrition, attempts were made to find the sources of their information in nutrition and health related areas. No difference was seen between the two groups in their information sources. Both groups reported mothers, teachers and friends as their main information sources along with media and other publications. A person's knowledge on nutrition, diet related diseases, physical activity and weight reduction will certainly affect his way of life, food habits and physical activity which in turn will affect his weight status. Even though the scores of knowledge were average for both overweight and normal weight children, the difference between the scores was found to be significantly higher for normal weight children. Among overweight children, urban boys had the highest knowledge scores. The area wise and age comparison were also made and significant difference was noted in boys and girls of rural and urban areas.

As expected the knowledge scores of the children improved significantly with gradation in age. Overweight urban boys revealed better knowledge than their rural counterparts. But among overweight girls, rural girls had higher knowledge scores than urban girls.

When normal and overweight children were compared, significant difference was seen only in rural girls. However, when area wise comparison of the attitude scores of overweight children were compared, rural girls and urban boys got better scores with significant difference.

The results revealed that both knowledge and attitude scores were not very high both in overweight and normal weight children but it was comparatively better in normal weight children revealing a significant difference than overweight children. This confirms that nutritional knowledge and attitude can influence the weight of the children. An earlier study done by Perron and Endrews (1985) pointed out that nutritional knowledge and attitude was positively connected so that, more the knowledge on nutrition, better or more positive was the attitude towards nutrition and vice versa.

When the scores of nutrition related practices, exercise and physical activities observed, a significant difference was noticed between overweight children and the normal weight children where the scores of normal weight children were significantly higher. This portrays that normal weight children as in the case of knowledge and attitudes were adopting better nutrition and activity related practices which in turn is reflected in their weight status. The difference in nutrition and activity related practices among overweight rural girls and boys were found to be significantly higher than their urban counterparts. However, no age wise difference was noted in nutrition related practices among overweight girls or boys.

Thus from the results of the study it is apparent that even though the selected children had average scores on knowledge and attitude towards nutrition, and the ill effects of wrong foods, it was not seen in their practices. Majority consumed energy dense ready to eat food items and have an irregular food intake pattern with sedentary life style. Children were very much aware of the problems that can result from the consumption of fast foods, carbonated beverages and other energy dense bakery items which promoted weight gain. It can be assumed that the children still continue to

consume these obesogenic harmful food items and do not engage in enough physical activities only because of lack of time for a proper meal, lack of time to exercise or to play or inconvenience of parents to make balanced meals or in order to save time for other activities. Concurrent results were observed in the studies by Kumudini (2003) on adolescents who reported that teenagers consume fast foods because of its easy availability and it is less time consuming but at the same time tasty in accordance with adolescent tastes. Children are forced to use their play time for additional studies. Games or physical training sessions are restricted or non existent in many schools. Some schools do not have any playgrounds at all. Erosion of open spaces for exercise, inadequate play areas and lack of parental time to supervise play are all part of new obesogenic lifestyles.

5.9 Impact of Diet counseling and Health Education

Long-term studies have shown that interventional programmes in children are far more successful and cost effective than in adults. Obesogenic food intake behaviours and sedentary habits are not well developed in children and therefore more amenable to change. An overwhelming body of evidence now indicates that prevention must begin in childhood to reduce the burden and cost of obesity in society (Lobstein et al., 2004). With this view in mind, a diet counseling and education intervention was planned for overweight micro sample and their families.

Children and families who were interested and motivated to lose weight were selected for counseling and health education. Those who appeared disinterested, apathetic with poor willingness to comply with the dietary restrictions were excluded from the study. The height, weight, BMI and body fat of the subjects were recorded initially along with the assessment of their initial nutritional knowledge and attitude towards physical activity and weight normalcy. Diet counselling and health education to children and families (mostly mothers) were given with follow up motivation sessions as well as telephone follow ups for a period of six months. Nutrition education booklets were given to each child and family along with a diet/ menu pattern for weight reduction. The height, weight, BMI and body fat were recorded again and evaluated at the end of six months. The change in nutritional knowledge scores and attitude towards physical activity and weight normalcy were also assessed.

Results of the study were quite encouraging with significant difference in before and after values of weight, BMI and body fat. As expected the difference in height was not significant. The reduction in weight, BMI and body fat was significantly higher in overweight children compared to that of normal weight children who did not receive any counselling. The differences in knowledge and attitude were also higher after counselling, however the difference was not significant. The overweight children were noticed to be clearer on their knowledge regarding nutrition, energy intake, physical activity and weight reduction of which they were ignorant or doubtful before. This has also reflected in their life style pattern. The diet modification suggested were followed by 80 percent of the children and also the change in their life style could be seen from their interest in engaging in regular physical exercises, active games or sports. Some children even started to go to school and tuition centres either by walking or cycling.

The change in the attitude and practices of the children was mainly due to sufficient encouragement and support given by their parents, especially mothers. Mothers were very much motivated by the nutrition education and diet counselling sessions and they took special interest in bringing their children to the follow up sessions and others with weighing balance at home were very glad to do telephone follow up sessions and let the investigator know the weight reduction and the modified life style pattern they were following at home. Therefore the regular attention of the mothers in the intervention sessions and their keen interest in following the diet modification and activity changes were the main reasons behind the weight reduction. Also, they expressed the need for more such counselling sessions to learn to manage and maintain the overweight in their children. However, not so much interest was shown by the fathers of overweight children. The results of the study suggests the need for starting diet counselling centres and service units which overweight children and their parents can attend anytime. Even though teachers and school authorities in many schools were initially not very keen in the interventions, the noticeable changes seen in the overweight children have motivated them too. They have also expressed the need for conducting such awareness creation and nutrition education seminars to the whole children of the school with special invitation to their parents for attending the seminar.

Another interesting factor which was observed during counselling was that setting a monthly or bi weekly weight loss goal for the overweight child and monitoring system from the health care worker goes a long way in constant weight reduction. Children who had routine follow up visits consistently lost weight on their every visit compared to children who were had telephone follow ups and those who were not able to do follow up visits regularly.

It could also be observed from the study that the children were under a lot of stress or tension due to the academic pressure at school, tuition, extra classes and other burden of studies. They hardly had time to eat a proper breakfast before the school time in the morning. Due to this reason a good majority of the children tended to skip breakfast. When they felt hungry in the school, they approached fast food places, bakeries or canteens during break times at school where they ate nutritionally inadequate energy dense foods. Even after school timings children were not quite free to engage in games or other physical activities for leisure or enjoy a nutritionally balanced meal as they had to go to tuition centres or prepare for exams. Concurrent studies by Malathi (2002) is also in agreement with the fact that a busy adolescent often skips breakfast and have snacks and soft drinks for lunch and also have junk foods instead of taking dinner.

Thus the busy life style of today's children with an abundance of academic pressure, lack of physical activity, and increased intake of energy dense food items were noticed to be the major contributing factors in the development of overweight and obesity in the present study. Hence intervention programmes should be designed in such a way by reducing the stress and tension of the children and by involving teachers as well as parents of overweight children to make learning more fun rather than physically and emotionally taxing for the children. This can be achieved by incorporating more physical education hours at school, reducing work load at school, by reducing tuition classes and extra classes, reducing pressure from the parents for academic performance and most importantly by adopting healthy and balanced food consumption habits along with ample physical activity for being fit and healthy. School authorities can take initiative on a weight loss campaign in their school by adopting various 'healthy kid' programs and by rewarding kids who maintain a healthy body weight during every school health checkup. Overweight children identified during health checkup can be asked to wear different

colour uniforms during physical education classes and this gives motivation for the overweight kid to lose weight and to wear normal uniforms to fit in the crowd. When the child loses weight, he can also be rewarded for his accomplishment. Also, school authorities can take actions to serve only healthy food items in the school canteen and to deny access to the children to go outside of the school during school timings to fast food places and restaurants outside. Thus, an integrated effort of the parents, children and school authorities can go a long way in motivating the child to lose excess weight and to be physically fit and to adopt healthy food choices.

5.10 Interrelationship between variables selected for the study

Anthropometric measurements, height and weight are the main factors involved in the calculation of Body Mass Index (BMI). Therefore, as expected strong positive correlation was noticed between these variables in both overweight boys and girls. The strong positive correlation of BMI with body fat and waist circumference indicates that the body fat and waist circumference also increases with the increase in BMI. Therefore, it can be assumed that the use of BMI as a screening tool for overweight and obesity is appropriate.

The sedentary activities of overweight children were negatively associated with moderate and heavy activity. The activity pattern of overweight children showed that they mostly spend their time on sedentary activities and therefore they are less likely to spend time on more physically exerting activities. It was also found that knowledge of the overweight children was positively correlated with their attitudes and practices. The scores of overweight children in knowledge, attitude and practices were significantly lower than normal weight children. However, it indicated that improving the knowledge of overweight children is the best way to improve their attitude and practices towards nutrition, to develop healthy eating habits, adequate physical activity and for weight reduction.

When formulating and designing interventional programmes in the prevention and management of overweight and obesity, knowledge or awareness creation among the overweight children themselves along with the key family members is the key to its success. Opportunities for improving the awareness on right food and life style habits

should be given for every child from preschool age to adolescence to ensure a future healthy generation.

6. SUMMARY

The study entitled “Contributing factors and problems associated with overweight among rural and urban school children” was undertaken with the major objective to assess the contributing factors and related problems due to overweight among rural and urban school going children and to find out the impact of diet counselling. The specific objectives set forth for the study were:

1. To screen and classify the children into overweight and normal weight groups based on standard obesity indicators like anthropometric measurements and body fat percentage.
2. To understand the influence of socio-demographic features, dietary habits and activity pattern on the weight status/adiposity in children.
3. To estimate and compare the quantitative and qualitative adequacy of the diets of overweight children with normal weight children.
4. To find out the knowledge, attitude and practices of the overweight and normal weight children towards nutrition, diet related diseases, physical activity and weight reduction.
5. To study the physical, health, academic, psychosocial and behavioral adjustment problems associated with overweight and obesity in children
6. To evaluate the effectiveness of health education and diet counselling to parents and overweight children in weight reduction.

A total of 3886 children from 10 schools were screened for overweight and obesity using standard overweight/obesity indicators. The sample selected for the study comprised of a total of 840 school going children of which 720 belonged to the experimental group of overweight children and 120 belongs to the control group of normal weight children. The sample was selected from 10-15 years of age group with equal number of boys and girls from each of the six age groups selected from rural and urban areas of Thiruvananthapuram District. A comprehensive analysis of socio economic and demographic features, time utilization, activity pattern and dietary profile of the subjects were carried out to find out the contributing factors behind the

development of overweight and obesity in school going children. A probe into the health, physical, academic areas and also their psychosocial and behavioural adjustment problems was undertaken to get a picturesque and exhaustive information on the problems associated with overweight and obesity. A systematic and in-depth appraisal to understand the dietary adequacy, macronutrient intake, energy balance and also the impact of diet counselling and health education was carried out on a micro sample of 120 children selected from the macro sample of 840 overweight and normal weight children. The data collected was statistically analysed to determine the significant difference between the overweight and normal weight children in the areas studied and also to give the relationship or association of the variables selected for the study.

The major findings of the study are:

- From the total of 3886 children screened, the overall prevalence of childhood obesity was found to be 4.99 per cent, 17.73 per cent were overweight when only 58.67 per cent were normal weight, 16.16 per cent were under weight with a BMI less than 15, and 2.44 were severely malnourished with BMI less than 13.
- An interesting observation made was that the overall prevalence of overweight and underweight was comparable at 16 to18 percent. The study thus proved that even though the indicators of over nutrition like overweight and obesity are rising disturbingly, undernutrition is still a problem even in Kerala which has a high number of successful intervention programs in health and nutrition and successful record of services in maternal and child health.
- When rural girls and urban girls were compared, the prevalence of obesity was more than double in urban girls (2.25 per cent and 5.26 per cent respectively). Similarly, overweight was also higher with almost double the prevalence in urban girls (11.92 per cent and 20.90 per cent respectively) than rural girls.
- Similar trend was seen among boys also. The obesity prevalence among rural boys was 3.84 per cent, and it was 6.73 per cent in urban boys. And overweight was 8.31 per cent in rural boys and 21.31 percent in urban boys with almost twice the prevalence in urban areas. The results thus revealed that overweight and obesity are more seen in urban areas than rural areas regardless of sex wise difference.

- When sex wise comparison of obesity among the total girls and total boys were made, obesity was almost double in boys (3.79 per cent and 5.99 percent respectively) and overweight was 16.39 per cent in girls and 18.80 percent in boys. The results suggested that overweight prevalence is almost similar in boys and girls while there was a significant difference in the case of obesity where more boys were obese than girls.
- Region wise comparison of anthropometric measurements revealed that there was significant difference at 1 per cent level in body weight, BMI, body fat, waist circumference, waist:hip ratio and MUAC of overweight and normal weight children.
- The sample as a whole form two homogeneous groups with most of the overweight children hailing from middle income and upper middle income whereas majority of the normal weight children were from lower middle income and middle income showing that income is a contributing factor for overweight and obesity. Majority of the children in both groups were from nuclear families with one or two siblings and with parents having good education and employment status. A greater majority of overweight children were living in own houses. However, the difference in basic utility services like water, electricity, sanitary facilities and family conveniences like refrigerator, modern kitchen appliances, television and vehicles for transportation was not significant between the two groups. As per the study, the major portion of family income was spent on food by both groups; however families' of overweight children were noted to be spending higher amounts for food which included the expenses for eating out and purchase of costly energy dense snack items.
- The study of the familial details on the sample revealed an association at 1 percent level between familial history of obesity and overweight/obesity in children. Similarly, ordinal position in the family and number of siblings in the family was also revealed to have a strong association with overweight in children.
- The dietary habits and preferences of the sample studied were in par with earlier studies done in this field with significant difference between overweight and normal weight children. When compared to normal weight children, overweight

children preferred meat, egg, and energy dense foods like fast foods, soft drinks, snacks, sweets and other hotel and bakery food items and did not like green leafy vegetables and other vegetables much. Unlike normal weight children, most of the overweight children skipped meals especially breakfast due to lack of time and appetite in the morning and resorted to energy dense bakery items like meat puffs and sweets during break time at school. Results revealed that frequent snacking habits/nibbling habits seen in overweight children could also be a contributing factor of overweight/obesity.

- The study also revealed that majority of the sample in both groups were non – vegetarians. The intake of cereals, meat group, snacks, hotel/canteen foods, and sweets were higher in overweight children. Similarly, the intake of macronutrients like carbohydrate, fat and protein were also significantly higher in overweight children.
- The activities and time utilization pattern of the overweight and normal weight subjects were noted to have a significant contribution to their weight condition. When there was not much difference noted in the moderate activities of the two groups of children, the sedentary activities were significantly higher and heavy activities were significantly lower in overweight children confirming the proved fact that the lesser the energy spent, more is the gain in weight.
- The evaluation of the energy balance computed from energy intake and energy expenditure revealed the following. The difference in energy intake and the positive energy balance was found to be significantly higher in overweight children compared to that of normal weight children indicating the need for maintaining an energy balance consistently for maintaining normal weight.
- The knowledge, attitude and practices of the children were assessed in the areas of nutrition, diet related diseases, physical activity and weight reduction. Significant difference was seen in the knowledge of overweight and normal weight groups in all the three areas with normal weight having higher scores indicating better knowledge, right attitude and correct practices. The age wise differences between different groups were also significant with a significant improvement in knowledge attitude and practices with gradation in age. However the rural and

urban difference was not found to be significant among the groups. The results once again proved that knowledge, attitude and practices related to nutrition definitely have an influence on the nutritional status of the individual.

- When the problems associated with overweight and obesity were assessed, overweight children were noted to have more problems associated with puberty like early menarche, problems with menstrual bleeding in girls while early/late voice change and appearance of facial hair and secondary sex characteristics were seen in boys. The health and physical problems, though not very prominent in both weight groups, the percentage of overweight children having health and physical problems were comparatively higher. Similarly, the psycho social and behavioural adjustment and academic problems in overweight children were significantly higher than normal weight children. Overweight children had more problems in all the areas studied. They revealed problems in self physical perception, attitude and behaviour towards family members, in their emotional and social behaviour and also in their perception of values and adjustments. The academic problems in overweight children were also noted to be higher.
- The results of the diet counselling and health education imparted for a period of six months revealed a significant difference at 1 per cent level in the before and after values of weight, BMI and body fat of overweight children. Overweight children who received diet counselling and health education showed significant reduction in weight, BMI and body fat when compared to that of control group.

In sum, the study revealed a significant difference between overweight and normal weight children in most of the areas studied. Family history of obesity, high financial status along with the busy life style of today's children with an abundance of academic pressure, lack of physical activity or sedentary life style, low energy expenditure and excessive intake of energy dense food items and other faulty dietary habits were noticed to be the major contributing factors towards the development of overweight and obesity in children. Overweight and obese children were also found to have significantly higher pubertal problems, health, physical, academic, psychosocial and behavioural adjustment problems than normal weight children. However the study proved that, with proper dietary and behavioural interventions along with constant help,

support, encouragement and motivation from all the family members and health care professionals, overweight children can definitely regain and maintain their ideal body weights and lead a normal healthy way of life.

Since overweight and obesity is an alarming growing epidemic, it needs to be prevented and corrected at the early stages itself by creating effective intervention programmes and strategies by the Government, public health officials and educational institutions. It was encouraging to observe the interest and cooperation of the subjects and their parents in managing this epidemic However, present study was confined to 840 children in one district of Kerala only and it was not adequate to impart changes in life style of a large number of other overweight and obese children who were not part of the study who will also benefit from similar intervention programmes. Therefore, a mass awareness creation of obesity and associated problems along with diet counseling and promotion of healthy eating and physical activity habits is very important.

Albeit at present, no irreversible damages or problems are seen in overweight children, if the same pattern of energy intake and sedentary life style habits is continued, in no time overweight and obese children can become morbidly obese with serious health implications like diabetes, hypertension, cardiovascular problems, and various types of cancer and morbidities which can really shorten their life span.

Obesity prevention campaigns will have to be carefully worded to avoid conflicting messages and deleterious results. The control of this epidemic is a challenge and requires strong social and political will in addition to medical management. A concerted public health approach will be required for effective prevention. The whole family, indeed, the whole society must be targeted for the health of the future generation.

The results obtained also suggest the intervening role of socio-economic and demographic environment, knowledge, attitude and food habits, life style pattern, work load and psychosocial adjustments on the dietary profile of overweight children. This prompts for further researches to improve the nutrition related knowledge of children and to inculcate the importance of leading a healthy life style which incorporate ample physical activity with decreased work load and tension. Urgent measures to improve the

food habits of school going children are also recommended. Parents are the key players when developing interventional programmes for children. Therefore, interventional programmes should be planned in such way that will create awareness in parents about the importance of weight reduction in leading a healthy life with lesser physical, psychosocial and health problems through proper diet and adequate physical activity.

It is hoped that the present study with all the limitations is expected to serve as a source of information for nutritionists, doctors, educationists, policy makers and other investigators to conduct both intensive and exhaustive researches in this field. Also it is hoped that the present study may open avenues for further research and to take up intervention programmes which are practically non existent in the prevention and management of this alarmingly growing epidemic of childhood obesity. Furthermore, the study will also serve as a guide for the growing children of different age groups to have an insight into their dietary profile to improve their food consumption pattern, dietary habits and to plan their work and time effectively incorporating more exercise and physical activity. Also, this can act as an eye opener to children and parents who frequent fast food units and those who have developed the habit of frequent snacking instead of taking up a nutritionally balanced diet that promotes good health.

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CONTRIBUTING FACTORS AND PROBLEMS ASSOCIATED WITH OVERWEIGHT AMONG RURAL AND URBAN SCHOOL CHILDREN

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8. ABSTRACT

We live in an energy sparing society today. Changes in diet coupled with increasingly inactive life styles have sparked off overweight and obesity in several countries of the world including India and Kerala. Overweight is associated with the onset of major chronic diseases leading to complications and also psychosocial problems in children and adults. The greater concern is that the risks of overweight during childhood will persist into adolescence and adulthood. Hence close monitoring of overweight prevalence in children and adolescents and taking timely preventive measures will be an effective approach in dealing with the problem of obesity.

The study entitled "Contributing factors and problems associated with overweight among rural and urban school children" was undertaken with the major objective to assess the contributing factors and related problems due to overweight among rural and urban school going children and to find out the impact of diet counselling.

A total of 3886 children from the selected schools were screened for overweight and obesity using standard overweight/obesity indicators. The sample selected for the study comprised of a total of 840 school going children of which 720 belonged to the experimental group of overweight children and 120 belongs to the control group of normal weight children. The sample was selected from 10-15 years of age group with equal number of boys and girls from each of the six age groups selected from rural and urban areas of Thiruvananthapuram District. A comprehensive analysis of socio economic and demographic features, time utilization, activity pattern and dietary profile of the subjects were carried out to find out the contributing factors behind the development of overweight and obesity in school going children. A probe into the health, physical, academic, psychosocial and behavioural adjustment problems was also undertaken to get a picturesque and exhaustive information on the problems associated with overweight and obesity. A systematic and in-depth appraisal to understand the dietary adequacy, macronutrient intake, energy balance and impact of diet counselling and health education was also carried out on the micro sample of 120 children selected from the macro sample of 840 overweight and normal weight children. The data collected was statistically analysed to determine the significant difference between the

overweight and normal weight children in the areas studied and also to give the relationship or association of the variables selected for the study.

The major findings of the study are:

From the total of 3886 children screened, the overall prevalence of childhood obesity was found to be 4.99 per cent, 17.73 per cent was overweight when only 58.67 per cent was normal weight, 16.16 per cent was under weight with a BMI less than 15, and 2.44 were severely malnourished with BMI less than 13. An interesting observation made was that the overall prevalence of overweight and underweight was comparable at 16 to18 percent. The study thus proved that even though the indicators of over nutrition like overweight and obesity are rising disturbingly, undernutrition is still a problem even in Kerala.

Region wise comparison of anthropometric measurements revealed that there was significant difference at 1 per cent level in body weight, BMI, body fat, waist circumference, waist:hip ratio and MUAC of overweight and normal weight children.

The sample as a whole form two homogeneous groups with most of the overweight children hailing from middle income and upper middle income whereas majority of the normal weight children were from lower middle income and middle income showing that income is a contributing factor for overweight and obesity. Majority of the children in both groups were from nuclear families with one or two siblings and with parents having good education and employment status. A greater majority of overweight children were living in own houses.

The dietary habits and preferences of the sample studied were in par with earlier studies done in this field with significant difference between overweight and normal weight children. Results revealed that snacking habits seen in overweight children could also be a contributing factor of obesity. The study also revealed that majority of the sample in both groups were non –vegetarians. The intake of cereals, meat group, snacks, hotel/canteen foods, and sweets were higher in overweight children. Similarly, the intake of macronutrients like carbohydrate, fat and protein were also significantly higher in overweight children.

The activities and time utilization pattern of the overweight and normal weight subjects were noted to have a significant contribution to their weight condition. The

sedentary activities were significantly higher and heavy activities were significantly lower in overweight children confirming the proved fact that the lesser the energy spent, more is the gain in weight.

The evaluation of the energy balance computed from energy intake and energy expenditure revealed the following. The difference in energy intake and the positive energy balance was found to be significantly higher in overweight children compared to that of normal weight children indicating the need for maintaining an energy balance consistently for weight maintenance.

The knowledge, attitude and practices of the children were assessed in the areas of nutrition, diet related diseases, physical activity and weight reduction. The difference was found to be significant between overweight and normal weight groups in all the three areas with normal weight having higher scores indicating better knowledge, right attitude and correct practices.

When the problems associated with overweight and obesity were assessed, overweight children were noted to have more problems associated with puberty like early menarche, problems with menstrual bleeding in girls while early/late voice change and appearance of facial hair and secondary sex characteristics were seen in boys. The health and physical problems, though not very prominent in both weight groups, the percentage of overweight children having health and physical problems were higher. Similarly, the psycho social and behavioural adjustment and academic problems in overweight children were significantly higher than normal weight children.

On assessment of the impact of diet counselling, a significant difference at 1 per cent level was observed in the before and after values of weight, BMI and body fat of overweight children. Overweight children who received diet counselling and health education showed significant reduction in weight, BMI and body fat when compared to that of control group.

The study revealed that family history of obesity, high financial status, and dietary factors like faulty dietary habits and excessive intake of energy dense foods along with increased sedentary life style and significant reduction in physical activity or energy expenditure form the major contributing factors towards the development of overweight and obesity. Overweight and obese children are also found to have significantly higher

pubertal problems, health, physical, academic, psychosocial and behavioural adjustment problems than normal weight children. However the study proved that, with proper dietary and behavioural interventions along with constant help, support, encouragement and motivation from all the family members and health care professionals, overweight children can definitely regain and maintain their ideal body weights and lead a normal healthy way of life.

The control of this epidemic is a challenge and requires strong social and political will in addition to medical management. The results obtained suggest the intervening role of socio-economic and demographic environment, knowledge, attitude and food habits, life style pattern, work load and psychosocial adjustments on the dietary profile of overweight children. This prompts for further researches to improve the nutrition related knowledge of children and to inculcate the importance of leading a healthy life style which incorporate ample physical activity with decreased work load and tension. Urgent measures to improve the food habits of school going children are also recommended. Parents are the key players when developing interventional programmes in children. Therefore interventional programmes should be planned in such way that will create awareness in parents about the importance of weight reduction in leading a healthy life with lesser physical, psychosocial and health problems through proper diet and adequate physical activity.

APPENDIX – I

International Obesity Task Force (IOTF) cut off points for body mass index for overweight and obesity by sex between 2 and 18 years				
Age (years)	Body Mass Index 25 kg/m2		Body Mass Index 30 kg/m2	
	Males	Females	Males	Females
2	18.41	18.02	20.09	19.81
2.5	18.13	17.76	19.80	19.55
3	17.89	17.56	19.57	19.36
3.5	17.69	17.40	19.39	19.23
4	17.55	17.28	19.29	19.15
4.5	17.47	17.19	19.26	19.12
5	17.42	17.15	19.30	19.17
5.5	17.45	17.20	19.47	19.34
6	17.55	17.34	19.78	19.65
6.5	17.71	17.53	20.23	20.08
7	17.92	17.75	20.63	20.51
7.5	18.16	18.03	21.09	21.01
8	18.44	18.35	21.60	21.57
8.5	18.76	18.69	22.17	22.18
9	19.10	19.07	22.77	22.81
9.5	19.46	19.45	23.39	23.46
10	19.84	19.86	24.00	24.11
10.50	20.20	20.29	24.57	24.77
11	20.55	20.74	25.10	25.42
11.5	20.89	21.20	25.58	26.05
12	21.22	21.68	26.02	26.67
12.5	21.56	22.14	26.43	27.24
13	21.91	22.58	26.84	27.76
13.5	22.27	22.98	27.25	28.20
14	22.62	23.34	27.63	28.57
14.5	22.96	23.66	27.98	28.87
15	23.29	23.94	28.30	29.11
15.5	23.60	24.17	28.60	29.29
16	23.90	24.37	28.88	29.43
16.5	24.19	24.54	29.14	29.56
17	24.46	24.70	29.41	29.69
17.5	24.73	24.85	29.70	29.84
18	25	25	30	30

Source: Cole et.al (2000)

STANDARDS FOR ARM CIRCUMFERENCE

Centimetres	100% of standard		90% of standard		80% of standard	
	M	F	M	F	M	F
1 month	11.5	11.1	10.3	10.0	9.2	8.9
2 months	12.5	12.0	11.2	10.8	10.0	9.6
3 months	12.7	13.3	11.4	12.0	10.2	10.6
4 months	14.6	13.5	13.1	12.1	11.6	10.8
5 months	14.7	13.9	13.2	12.5	11.7	11.1
6 months	14.8	14.3	13.2	12.9	11.9	11.5
7 months	15.0	14.6	13.5	13.2	12.0	11.7
8 months	15.5	15.0	14.0	13.5	12.4	12.0
9 months	15.8	15.3	14.2	13.7	12.6	12.2
10 months	15.8	15.3	14.2	13.8	12.6	12.3
11 months	16.0	15.4	14.3	14.0	12.7	12.4
1 year	16.3	15.6	14.4	14.0	12.8	12.5
2 years	16.8	15.9	14.7	14.4	13.0	12.8
5 years	17.0	16.9	15.3	15.2	13.6	13.5
6 years	17.3	17.3	15.6	15.5	13.8	13.8
7 years	17.8	17.8	16.0	16.0	14.2	14.2
8 years	18.4	18.4	16.5	16.6	14.7	14.7
9 years	19.0	19.1	17.1	17.2	15.2	15.3
10 years	19.7	19.9	17.7	17.9	15.8	15.9
11 years	20.4	20.7	18.4	18.6	16.3	16.5
12 years	21.2	21.5	19.1	19.3	16.9	17.2
13 years	22.2	22.4	20.0	20.2	17.7	17.9
14 years	23.2	23.2	20.9	20.9	18.6	18.5
15 years	25.0	24.4	22.5	22.0	20.0	19.5
16 years	26.0	24.7	23.4	22.2	20.8	19.7
17 years	26.8	24.9	24.1	22.3	21.4	19.9
Adults	29.3	28.5	26.3	25.7	23.4	22.8

International standards given here are from WHO Monograph No. 53, Jelliffe, 1976(3). It has been found that values for arm circumference of well-fed Indian school children are 90-97% of American values. However, Indian children of low socio-economic status only reach 10th percentile of such values(2).

N-4 Arm Circumference Measuring Tape (Insertion Type)

References

(1) Zerfas, A.J., Amer. J. of Clinical Nutrition 28 July, 1975, pp. 782-787.

(2) Vijayraghvan, Darshan Singh, Swaminathan M.C., Indian J. Med. Res. **62**, 7th July, 1974, pp. 994-1001.

(3) Jelliffe, D. B., The Assessment of the Nutritional Status of the Community, Monograph No. 53, WHO, Geneva, 1976.

INTERVIEW SCHEDULE TO ELICIT INFORMATION ON SOCIOECONOMIC AND DOMESTIC ENVIORNMENT OF THE RESPONDENT

A. PERSONAL AND SOCIOECONOMIC DETAILS

1. Name of the child: Sex: M/F

2. School : Class: Division:

3. Date of birth : 4 Age : …….. Years … Months

5. Religion : Hindu / Muslim / Christian 6 Caste : Forward /SC /ST/OBC

7. Place of residence : Rural / Urban / Suburban : 8. Location of Residence :

B. FAMILY BACKGROUND

1. Family type : Nuclear / Joint / Extended 2 Family size : 1-2 3-4 5-6 7-8

3. Ordinal Position : First /Middle /Last 4. Number of siblings:

5. Other Family Details

No	Name	Relation to the child	Age	Sex	Occupation	Income (Rs)	Ht in cm	Wt in Kg

C. ECONOMIC DETAILS

1. Total monthly income of the family :

a) Below Rs.1000 b) 1000 – 5000 c) Rs. 5000 -20,000 d) Rs. 20,000 -50,000 e) Rs. 50,000 and above

2. Average monthly expenditure pattern of the respondent's family:

Item	Below 500/-	500 – 1500/-	1500 – 3000/-	3000/- above
Food Clothing Housing Travelling Education Entertaining Health care Saving Miscellaneous				

D. DOMESTIC ENVIORNMENT

Infrastructure facilities

(Put ( ) at appropriate place)

1. Type of house

I II III IV

House	Roof	Wall	Floor
Own Rented Quarters Any other specify	Thatched Tiled Concrete Sheet Any other specify	Mud Wall Brick Wall Stone Wall Any other specify	Concrete Tiled Mosaic Marble Granite Any other specify

2. Necessities Available

Water	Light
Common well Own well Municipality Corporation Common pipe Any other specify	Electricity Solar Gobar Gas Kerosene Any other specify

3. Latrines, drainage and waste disposal

Latrine present or not	Number of latrines	Bedroom attached latrines Y/N	Have latrines But no drainage Y/N	Have latrines And drainage Y/N	Water Disposal (specify)

4. Facilities Available at home

Separate Rooms	Electrical appliances	Transport Facilities	Printed Media	Kitchen Appliances
For the child Entertainment Dining Sleep Cooking	Television Radio Tape Recorder VCR/VCP/ DVD Home Theatre Air conditioner	Cycle Motor Cycle Car Jeep Tempo Autorickshaw	Newspaper Magazine Children's Books	Refrigerator Gas Stove Microwave oven Mixy Grinder Pressure Cooker

4.1 Do you have house maid : Yes/No . If yes : Full time /part time/none

4.2 How do you spend most of your leisure time, rank according to priority ? : Watching TV / Watching movies / listening to music / day dreaming/ computer game / hobby /reading telephone

INTERVIEW SCHEDULE TO ELICIT TNFORMATION ON DIETARY HABITS AND FOOD CONSUMPTION PATTERN

Name: Sex – M /F Class: School:

Date of birth : Age: …….Year …….. Month……

A. FOOD HABITS

1**.** Vegetarian / Non vegetarian/Any Other

2. Are you a good eater ? : Yes / No

3. What is your opinion in dieting ? : Good/Bad

4. Do you skip any meal ?
   a) If yes which meal ? : Breakfast/ Lunch/ Tea/ Supper
   b) Why ? : Lack of time/ Lack of appetite/ Dislike of food / Dislike of food/ Lack of food/ Habit/Weight Control Measure

5. Which meal do you consume in great amount ? : Breakfast/ Lunch/ Tea/ Supper
   a) why ? :

6 Do you nibble in between meals ? Yes/No
   specify :

7. What do you prefer ? : Home food / Eating outside / Both

8. How many times you eat food from outside ? Daily/ Bi weekly/weekly/Monthly/ Rarely

9. Why do you prefer eating out?Variety/appetizing Food/Necessity/Convenience/Entertainment/Change

10. Type of food you prefer to eat out: Breakfast/ Lunch /Dinner/ Snacks/ Sweets/Beverages

11. What type of food units you frequent?: School Canteen/Bakery/ Mobile food units/Fast Foods/ Eat-in Restaurants/ Five Star Hotels/ Others

12. Do your parents permit you to eat out? Yes/ No

13.How often do you drink carbonated beverages and bottled juices?: Daily/ 2-3 times per week / weekly /fortnightly / Monthly/Rarely

B. DAILY DIETARY PATTERN OF THE RESPONDENT

Meals	Menu	Quantity (g)	Ingredients	Time

Early morning				
Breakfast				
Mid morning				
Lunch				
Tea				
Dinner				
Bed time				

C . FOOD USE FREQUENCY & FOOD PREFERENCE OF RESPONDENT

Food group items	Daily	Bi- weekly	Weekly	Fort nightly	Monthly	occassionally	Rarely	Never	Highly Preferred	Indifferent	Dislike
Cereals											
Rice											
Rice Flakes											
Puffed Rice											
Wheat											
Maida											
Atta											
Suji											
Vermicelli											
Ragi											
Barley											
Oats											
Pulses											
Bengal gram											
Bengal dhal											
Green gram											
Green gram dhal											
Red gram dhal											
Black gram dhal											
Horse gram											
Cow pea											
Green peas											
Soya been											
Leafy Vegetable											
Amaranthus Red											
Amaranthus Green											
Colocasia Leaves											
Curry leaves											
Drumstick Leaves											
Spinach											
Celery											
Food group items											
Agathi leaves											
Chekkur mains											
Cabbage											

	Daily	Bi- weekly	Weekly	Fort nightly	Monthly	Occasionally	Rarely	Never	Highly Preferred	Indifferent	Dislike
Roots & Tubers											
Arrow root											
Beet root											
Carrot											
Colocasia											
Onion small											
Onion big											
Radish											
Sweet potato											
Potato											
Tapioca											
Yam											
Any other Specify											
Other Vegetables											
Ash gourd											
Bittergoured											
Beans											
Cauliflower											
Cucumber											
Drumstick											
Jack, tender											
Ladies finger											
Mango green											
Onion stalk											
Papaya											
Plantain flower											
Plantain green											
Pumpkin											
Snakegourd											
Nuts & Oil Seeds											
Arecanut											
Cashew nut											
Coconut											

Food group items	Daily	Bi- weekly	Weekly	Fort nightly	Monthly	Occasionally	Rarely	Never	Highly Preferred	Indifferent	Dislike
Mackeral											
Pomfret , black											
Lobster											
Prawn											
Singhi											
Crab											
Ray											
beef											
Chicken											
Duck											
Pork											
Liver											
Egg, duck											
Egg , hen											
Mutton											
Milk & Milk Products											
Milk , buffalo											
Milk , cow											
Milk ,goats											
Curd											
Butter milk											
Skimmed milk											
Skimmed milk powder											
Whole milk powder											
Fats & edible oil											
Butter											
Ghee											
Oil											
Vanaspathi											
Sugar											
Sugar cane											
Honey											
Jaggery											

Food group items	Daily	Bi- weekly	Weekly	Fort nightly	Monthly	Occasionally	Rarely	Never	Highly Preferred	Indifferent	Dislike
Gingelly seed											
Ground nut											
Mustard seed											
Condiments & Spices											
Asafoetida											
Cardamom											
Chillies											
Cloves											
Coriander seed											
Ginger											
Garlic											
Pepper											
Nutmeg											
Tamarind pulp											
Turmeric											
Fruits											
Amla											
Apple											
Banana											
Cherries , red											
Dates											
Grapes											
Jack fruit											
Jambu fruit											
Lemon											
Mosambi /Lime sweet											
Orange											
Papaya											
Pine apple											
Plum											
Pomegranate											
Sapota											
Tomato ripe											
Water melon											
Fish & Other Sea food											
Sardine											
Oil Sardine											

Food group items	Daily	Bi- weekly	Weekly	Fort nightly	Monthly	Occasionally	Rarely	Never	Highly Preferred	Indifferent	Dislike
Mackeral											
Pomfret , black											
Lobster											
Prawn											
Singhi											
Crab											
Ray											
beef											
Chicken											
Duck											
Pork											
Liver											
Egg, duck											
Egg , hen											
Mutton											
Milk & Milk Products											
Milk , buffalo											
Milk , cow											
Milk ,goats											
Curd											
Butter milk											
Skimmed milk											
Skimmed milk powder											
Whole milk powder											
Fats & edible oil											
Butter											
Ghee											
Oil											
Vanaspathi											
Sugar											
Sugar cane											
Honey											
Jaggery											

Food preperations	Daily	Bi- weekly	Weekly	Fort nightly	Monthly	Occasionally	Rarely	Never	Highly Preferred	Indifferent	Dislike
Main dishes											
Bread											
Idli											
Dosai											
Chappathi											
Puttu											
Uppuma											
Pathiri											
Cornflakes											
Porotta											
Nan											
Pulav											
Fried rice											
Biriyani											
Plain rice											
If any other Specify											
Fast Foods											
Pizza											
Burger											
Sandwich											
Noodles											
Panipuri											
Chat Masala											
Puffs											
Vada											
Bonda											
Sweets											
Biscuit											
Cake											
Halwa											
Jilabi											
Ladoo											
Mysore pak											
Peda											
Groundnut cake											
Gingelly ladoo											
Chocolates											
Candies											

Snacks	Daily	Bi- weekly	Weekly	Fort nightly	Monthly	Occasionally	Rarely	Never	Highly Preferred	Indifferent	Dislike
Chips											
Pakoda											
Murukku											
Mixture											
If any other specify											
Desserts											
Custards											
Fruit salad											
Pudding											
Ice cream											
Beverages											
Complan											
Bournvita											
Horlicks											
Boost											
Cococola											
Sprite											
Coffee											
Tea											
Coconut water											
If any other, specify											

D. Major Sources on Food, Nutrition and Health (Mark 1, 2, 3 according to priority)

Mother		Teacher		Television	
Father		Books		Radio	
Grandmother		Magazine		Film	
Grand Father		Newspaper		Advertisement	
Sibling		Computer		Any other specify	

ANALYSIS OF COOKED FOOD

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The composite food analysis method gives accurate data regarding the nutrient intakes providing losses in cooking etc. But the method is time consuming and costly to be carried out on a large scale. This method involves the actual analysis of a composite sample of cooked foods consumed by the family members. This method involves the sampling of each item served during breakfast, lunch, tea and dinner with subsequent blending of representative samples and analysis for the various nutrients.

Sampling

For sampling the individuals are asked to consume each food of the meal by weight. About 10 per cent by weight of food consumed by an individual is taken as sample. All the items consumed throughout the day are kept in a container in the deep freezer. The foods are collected for three consecutive days or sometimes for seven days. Tea, coffee, milk, soup, etc. are also added by weight/volume.

Food samples are mixed and a ground to fine paste in a blender or grinding machine. The ground sample is dried in the oven and made into powder.

This powder or the wet ground samples (depends on nutrients) are used for assay of protein, fat, moisture, ash, calcium, phosphorus, iron or any other nutrient required.

The methods of analysis for proximate principles are given here for reference.

Moisture

Principle :

The sample is dried to constant weight in an air oven.

Apparatus

Oven : Temperature 100-102°C.

Dishes : Nickel stainless steel aluminium or porcelain. Metal dishes should not be used when the substance to be dried may produce corrosive action.

Desiccator : Containing dry phosphorous pentoxide, calcium chloride or granular silica gel.

Procedure

1. Dry the empty dish and lid in the oven for 15 min at 100°C and transfer to the desiccator to cool for about 10 20 min.
2. Mix the prepared sample thoroughly and transfer about 5 g to the dish. Replace the lid and weigh the dish and contents as rapidly as possible to the nearest mg.
3. Remove the lid and place the dish and lid in the oven avoiding contact of the dish with the walls. Dry for 6 h at 100°C. For products that do not decompose during long period of drying, it is permissible to dry overnight that is about 16 h.
4. Remove the dish from the oven, replace the lid, cool in a desiccator and reweigh when cold.
5. Dry for a further hour to ensure that constant weight has been achieved.

Calculation

Let weight (g) of sample = W_1

Lost of weight (g) = W_2

Weight of dried sample = W_3

Then moisture (%) = $\frac{W_2}{W_1} \times 100$

Total solids (%) = $\frac{W3}{W1} \times 100$

Total nitrogen and crude protein (Micro Kjeldahl method)

Principle

The product is digested with concentrated H_2SO_4 using $CuSO_4.5H_2O$ as a catalyst to convert organic nitrogen to ammonium ions. Alkali is added and the liberated ammonia is distilled into an excess of boric acid solution. The distillable is titrated with hydrochloric acid to determine the ammonia absorbed in the boric acid.

Equation

Organic $N + H_2SO \rightarrow (NH_4)_2SO_4 + CO_2 + H_2O$

$(NH_4)_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2NH_3 + 2H_2O$

$NH_3 + HCl \rightarrow . NH_4Cl$

Reagents

Sulphuric acid : Concentrated, nitrogen free.

Hydrochloric acid : 0.1 N standardised.

Boric acid solution : Dissolve 40 g of boric acid in H_2O and dilute to 1000 ml.

Sodium hydroxide solution (40%) : Prepare by dissolving 400 g carbonate free NaOH in distilled H_2O and dilute to 1000 ml.

Copper sulphate catalyst : Mix $CuSO4.5H_2O$ and potassium sulphate in the ratio of 1 : 9.

Mixed indicator solution : Dissolve 2 g of methyl red and 1 g of methylene blue or bromo-cresol green in 1000 ml of ethanol. Store in a dark brown bottle.

Boiling regulator : For the digestion, glass beads, silicon carbide or splinters of hard porcelain.

Apparatus

Kjeldahl flask 800 ml capacity.

Distillation apparatus.

Heating device.

Procedure

1. Place a few boiling regulators in the Kjeldahl flask and pinch of the catalytic salt mixture.
2. Weigh 2 g of the sample and transfer to the Kjeldahl flask.
3. Add 20ml sulphuric acid and mix by gently swirling the liquid.
4. Heat the flask gently until foaming has ceased.
5. Digest by boiling vigorously, occasionally rotating the flask until the liquid has become clear and of a light blue green colour.
6. Cool to about 40°C and add continuously about 50 ml of water. Mix and allow to cool and dilute to make 100 ml in a volumetric flask.

Distillation

1. Add 10 ml of the boric acid solution to 150 ml conical flask. Add 2-3 drops of mixed indicator. Put the flask in contact with the condenser.
2. Transfer 2 ml of the aliquot to the distillation flask and rinse the inlet with water.
3. Pour 10 ml of NaOH solution into the distillation apparatus and stopper the inlet.
4. Distil at least 80 ml of distillate.
5. Rinse the outlets with water.
6. Verify the completion of ammonia distillation by testing the distillate from the condenser with red litmus paper.
7. Titrate the contents of the flask with 0.01N HCl. Record the volume of HCl used to the nearest 0.02 ml.

Blank reading : Conduct a blank following the procedure except for addition of the sample.

Calculation

Let weight of the sample taken (g)	=	W
Volume of aliquot made	=	100 ml
Volume of aliquot taken for distillation	=	2 ml
Volume of HCl (N/100) used in titration for sample	=	V_1
Volume of HCl (N/100) used in titration for blank	=	V_2

Total nitrogen (%) = $\frac{0.00014(V_1-V_2) \times 100 \times 100}{2 \times W}$ = x

Crude protein (%) = x X 6.25

Lipids (Soxhlet method)

Total Fat

Principle

The fat is extracted with petroleum ether from the dried sample. The solvent is removed by evaporation and the residue of fat is weighed.

Reagents

Petroleum ether, boiling range 40-60°C.

Apparatus

Soxhlet extraction apparatus.

Air oven.

Extraction thimbles.

Procedure

1. Take about 5 g well ground dried sample in an extraction thimble.
2. Place the thimble in the extractor and connect a weighed flasks containing 100 ml petroleum ether. Connect the extractor to a reflux condenser.
3. Extract the sample under reflux for 5-6 h.
4. Evaporate the petroleum ether extract to dryness and add 2 ml acetone. Blow air gently into the flask to remove the last traces of solvent.
5. Dry the flask containing the fat residue in an air oven at 100°C for 5 min. Cool in a desiccator and weight.

Calculation

Let weight (g) of sample before drying = W_1

Weight (g) of flask empty = W_2

Weight (g) of flask with fat = W_3

Then extractable fat (%) = $\frac{W_3-W_2}{W_1} \times 100$

Notes:

1. If the ash is to be used for trace elements or phosphorus determination, clean the crucibles by boiling in 6N HCl and rinse with distilled water.
2. Two rapid heating is to be avoided since some of the salts will fuse and absorb carbon which is difficult to ignite. The use of too high temperature may also cause some losses of volatile salts such as sodium and iron chloride.

Crude fibre

Principle

A fat free sample is treated with boiling sulphuric acid subsequently boiling sodium hydroxide. The residue after substraction of the ash is regarded is fibre.

Reagents

Hydrochloric acid 1% v/v.

Sulphuric acid stock solution 10% w/v : Take 55 ml conc. H_2SO_4 and dilute to 1 litre.

Sulphuric acid working solution : Dilute 125 ml of the stock solution to 1 litre.

Sodium hydroxide stock solution 10% w/v : Dissolve 100 g NaOH in water to dilute 1 litre.

Sodium hydroxide working solution 1.25% : Dilute 125 ml of the stock solution to 1 litre.

Antifoam : 2% silicon antifoam in CCl_4.

Procedure

1. Weigh (1-2) of fat free dried sample in a 1 litre tall beaker.
2. Add 200 ml 1.25% (hot) H_2SO_4 and few drops of antifoam.
3. Heat to boiling within 1 min on the crude fibre apparatus.
4. Keep the solution boiling exactly for 30 min under bulb condensers. Beaker may be rotated occasionally to mix the contents and remove the particles from the side.
5. Filter the contents of the beaker through Buchner funnel.

SCHEDULE TO COLLECT INFORMATION ON THE RESPONDENTS TIME EXPENDITURE PATTERN OF A WORKING DAY AND A HOLIDAY

Name of the child : Sex – M / F

Address :

Home	School

Date of birth : Age…… Year…….. Month

Working Day :

No.	Activity	Time
	Wake up Go to Bed	From ----------To (Specify In Hours & Minutes)

ASSSSMENT OF HEALTH PROFILE OF THE CHILD

1.1 Name: Sex : M/F :

Name of School :

1.3 Date of birth : 1.4 Age : …….. Years … Months

1.5 Current Body Weight: 1.6 Height in cm

B1 . Birth history

1.1 Birth weight (kg) …… 1.2 Birth length (cm)……

1.3 Type of delivery – Normal/Caesarian/Forceps/Vacuum 1.4 Birth term- Normal/premature/post mature

1.5 Immunisation taken Yes/No

2.4 Do you or any of your family members have the following health problems (Specify who against each health problem).If yes, for how long

Disease	Father	Since Year	Mother	Since Year	Siblings	Since Year	Self	Since Year
Diabetes								
Hypertension								
Heart Disease								
Over weight								
Obesity								
Asthma								
Epilepsy								

3. PHYSICAL PROBLEMS

No	Problems With	Yes	No	Specify
1	Eating			Lack of appetite/ excessive hunger/other
2	Sleeping			Lack of sleep/always sleepy/other
3	Exercise			Lack of energy/other
4	Walking			Difficulty walking/leg ache/ other
5	Eye problems			headache/squint/short sight/other
6	Ear problems			Pain/itching/wax/discharge/hearing loss/other
7	Dental problems			Toothache/gumbleeding/malocclusion/caries/ bad breath/other
8	Hair/Face problems			Lice/dandruff/falling hair/pimples/scars/other
9	Skin/Nail problems			White patch/hirsuitism/itching/excessive sweating/body odour/ acne/nail infection

4. PROBLEMS RELATED TO PUBERTY

No	Problems with Menstruation In **Girls**	Yes	No	Specify
1	Age at Menarche			Early/Late/Normal
2	Menstrual Problems			Irregular/scanty/profuse/discharge/other
3	Pain			Severe head ache/backache/abdominal cramps/body ache/limb ache
4	Other discomforts			Restlessness/nausea/vomiting/irritability/ Over sensitivity/emotional/mood problems/other
5	Problems related to appearance of secondary sex characteristics **(Boys)**			
6	Age of cracking of voice			Early/Late/Normal
7	Appearance of facial hair			Early/Late/Normal

5. General Health

No		Yes	No
1.	I feel burning sensation in the eyes		
2.	I cannot see with out spectacles		
3.	My appetite is not good		
4.	I feel heaviness in the eyes		
5.	I belch a lot after eating		
6.	I feel shaky in my limbs and body at times		
7.	I feel tired all the time		
8.	My digestion is poor		
9.	I get headaches frequently		
10.	I suffer from constipation regularly		
11.	I usually get swollen ankles		
12.	I get diarrhea when I eat a lot		
13.	I often experience bodyaches		
14.	I often experience numbness and tingling sensation in the hands and feet		
15	I often suffer from backaches and leg aches		
16.	I feel shortness of breath when I climb stairs		
17.	I sweat a lot even in cold weather		
18.	I get sick very often in an academic year		
19	I get abrasions on my thighs when I walk or run		
20.	I find it very difficult to cross roads fast		
21.	It is very hard for me to participate in games and sports which needs some physical activity		
22.	I cannot survive with out a fan or A/C		
23	I feel hot all the time		
24.	I cannot run fast due to my weight		

PSYCHO SOCIAL AND BEHAVIOURAL ADJUSTMENT SCALE

AMBILY G. UNNITHAN, Dr. S. SYAMAKUMARI

Given below are series of statements. Five choices namely Strongly agree / Agree / Doubtful / Disagree /Strongly disagree are given for each statement. Mark the one which you think is the most appropriate one for yourself. There are no right or wrong answers. Responses will be kept confidential for research purposes.

Name: Class: Div: Age: Rural/Urban

A	**Perception of Physical Attributes**	Strongly Agree	Agree	Doubtful	Disagree	Strongly Disagree
1	I love to sleep most of the time during holidays					
2	I always dress neatly					
3	I have a very pleasing personality					
4	I am satisfied with my looks					
5	I like to walk in the evening for exercise					
6	I am not active like my friends					
7	My appearance always embarrass me					
8	I am very conscious and shy to exercise in front of others					
9	I am capable of doing physically exerting jobs					
10	I wish I were more beautiful					
11	I am very good in sports					
12	I find it difficult to get readymade dresses of my size					
13	I do not like to participate in extracurricular activities					
14	I like to be active all the time					
15	I have no problem in being fat					
16	I am physically very strong					
17	I wish I could be thin					
18	I am very healthy person					
19	I am an average looking person					
20	I am always appreciated for being a well dressed person					

B	**Attitude & Behaviour In Family**	Strongly Agree	Agree	Doubtful	Disagree	Strongly Disagree
1	I try to be punctual and regular in my activities					
2	I am not scared to approach my parents when I am in trouble					
3	I like to help mom in household chores					
4	My suggestions are always welcomed at home					
5	I feel hesitant to take my friends home					
6	My parents expect me to study all the time					
7	I like to sit at home and watch TV all day					
8	I always feel hungry					
9	My parents encourage me to exercise					
10	My mother never force feed me					
11	I always find time to eat a good breakfast					
12	I usually go to bed with out supper					
13	My parents control the amount of food I eat					
14	My brother/sister make fun of me for overeating					
15	My parents are not conscious of my overweight					
16	I like to snack throughout the day					
17	I never skip meals to reduce weight					
18	All the members in my family eat together for dinner					
19	I try to be eat my meals at regular times					
20	My parents think that being chubby is very cute and healthy					

C	**Emotional Characteristics & Behaviour**	Strongly Agree	Agree	Doubtful	Disagree	Strongly Disagree
1	I am always frustrated about something					
2	Tension makes me eat a lot					
3	I try to get the best out of my life					
4	I am not capable of expressing my views freely					
5	I always like changes in my life					
6	I never run away from problems					
7	I am very satisfied in my life					
8	I do not feel interested in doing anything					
9	I find it hard to take ‘no’ for an answer from anybody					
10	I am easily hurt when others find fault with me					
11	I can easily take firm decision					
12	I am very generous and selfless					
13	I am often troubled with feelings of guilt					
14	I often feel like committing suicide					
15	Most of the fashionable dresses does not suit me					
16	I am always irritable					
17	I cannot manage any problematic situations					
18	I am a very happy person					
19	I do not think that my overweight is a problem in attaining my goals					
20	I feel confident when people look at me					

D	**Social Behaviour**	Strongly Agree	Agree	Doubtful	Disagree	Strongly Disagree
1	I do not like to share my belongings or things					
2	I find it difficult to mingle in social functions					
3	I do not like to sit with thin kids in the class room					
4	I feel it easy to make new acquaintance					
5	I cannot impress people					
6	I like others to consider me important					
7	I am shy before a camera					
8	I never quarrel with others					
9	I feel I can never have a close relationship with anyone					
10	I feel better when I am alone					
11	Others find fault with me without any reason					
12	My suggestions are always welcomed by my friends					
13	Other kids always tease me and irritate me					
14	I never offer my notes to class mates					
15	I find it difficult to speak in public					
16	My friends entrust me their problems with full confidence					
17	I have plenty of friends of my age					
18	I try to correct myself whenever I make mistakes					
19	I help my friends even if I have to go out of the way to do so					
20	I can impress others					

E	**Academic Behaviour**	Strongly Agree	Agree	Doubtful	Disagree	Strongly Disagree
1	Teacher always value my opinion and answers					
2	I solve my problems easily					
3	I try to get victory in every activity					
4	I always win prizes in debate and quiz					
5	I am fed up of studying					
6	I believe that hard work pays in the end , for a student					
7	I look forward to going to school					
8	I find it difficult to concentrate in class					
9	I am very systematic in my work					
10	Teachers like me because I study well					
11	I am more intelligent than most children of my age					
12	I never get depressed in times of failures					
13	My teachers tease me for being fat					
14	Teacher always fails me because I am overweight					
15	I am determined to achieve what I want in life					
16	I cannot study well since I am fat					
17	I can find a job whenever I want					
18	My friends share their secrets with me					
19	My classmate’s views differ from mine all the time					
20	I always get good marks					

F	**Values and Adjustment**	Strongly agree	Agree	Doubtful	Disagree	Strongly Disagree
1	I believe life is just one worry after another					
2	I believe that regular and organized work will pay					
3	Forgiveness is a sign of strength					
4	Truth and honesty are of no use in the world					
5	I do not consider it proper to make fun of others					
6	I feel that the money is not the most important thing in life					
7	When a senior person mistreat me I feel it is better to ignore than react					
8	It is good have clear cut ideas about ones future					
9	I consider it improper for a teacher to be partial to the students					
10	Going on strike is a wastage of time and energy					
11	I enjoy teasing people even if it hurts them					
12	One should always be faithful to ones friends					
13	Teasing a new teacher in class provides lots of fun					
14	Students have no responsibility towards the upkeep of the school					
15	I like to share my joys and sorrows with others					
16	I think education is more valuable than money					
17	Rich students can make friends easily than a poor student					
18	Women should be given more opportunity to compete with men					
19	I never disagree with rich folks					
20	If I were rich, I will share my money with the poor					

OBESITY RELATED KAP (OR_KAP) SCALE

AMBILY G. UNNITHAN DR.S.SYAMAKUMAI

Given below are series of statements. Three choices namely Yes/Doubtful/No are given for each statement. Mark the one which you think is the most appropriate one. Responses will be kept

confidential for research purposes

Name: Age: M/F: Age:

Rural/Urban

School: Class: Div:

No.	**PART I (A)**	Yes	Doubtful	No
1**A**	Balanced diet is very important to lead a healthy life			
2	Major nutrients are carbohydrate, protein and fat			
3	Germinated pulses do not contain Vitamin C			
4	Egg yolk is rich in cholesterol			
5	Vegetables should be washed after cutting in to small pieces			
6	Orange has better nutritional value than gooseberry			
7	Drumstick leaves are rich in Beta Carotene			
8	Soya milk is not equally good as cows milk			
9	Pressure cooking helps to prevent loss of nutrients when cooking.			
10	Vitamin C is not essential for iron absorption			
11	It is healthy to remove the skin of chicken before cooking			
12	Essential amino acids can be synthesized by the body			
13	Cereals are the major sources of vitamins in our food			
14	Balanced diet include food materials from all food groups			
15	Green leafy vegetables are rich sources of Vitamin K			
16	Balanced diet cannot be made from locally available foods			
17	Excess of vitamin A can lead to toxicity			
18	Pressure cooking helps to prevent loss of nutrients when cooking.			
19	Vitamin B is essential for energy metabolism			
20	Eating beetroot helps in blood formation			
	(B)			
1**B**	Consumption of fruits and vegetables will prevent constipation			
2	Bleeding gums is due to vitamin C deficiency			
3	Baked foods are better than fried foods for health			
4	Diabetes can be managed through a controlled diet			
5	Using aginomotto in food preparation is harmful to health			
6	Overweight and obesity are causes of gout and arthritis.			
7	Overweight is caused by excess consumption of energy			
8	Abdominal fat is one of the leading factor in the cause of diabetes			
9	Obesity usually lead to hypertension			
10	Chicken fried in reheated oil is very harmful to health			
11	Steamed foods are easy to digest than fried foods			

12	Inadequate diet in adolescence can affect the reproductive health			
13	Regular use of fatty foods lead to clogging of arteries and heart attack			
14	Vitamin A is necessary for healthy skin			
15	A thin person is never healthy			
16	Improper diet is one of the reasons for hypertension.			
17	Vitamin B complex deficiency can cause anaemia			
18	Taking tapioca and fish combination diet helps in preventing goiter			
19	Too much consumption of vanaspathy and dalda can cause cancer			
20	Pan chewing can cause cancer of the mouth			
	(C)			
1**C**	Salads should be used if you are planning to lose weight			
2	Vegetarian diet aids in weight reduction			
3	A low calorie diet should be followed to lose weight			
4	Fried foods should be avoided when on a weight loss program			
5	Children should be physically active to prevent weight gain			
6	Dalda is a good substitute for coconut oil for weight reduction			
7	Liberal use of fruits and vegetables will aid in weight reduction			
8	It is healthy to have drastic weight reduction in a short time			
9	A low fat diet will aid in weight reduction			
10	Weight once gained cannot be reduced at any cost			
11	Starvation is the only way for weight reduction			
12	Obese parents will have obese children			
13	Total calorie intake should be less than the daily caloric requirement for one to lose weight			
14	Taking a glass of water just before meals helps to lose weight			
15	Playing physically active games is important for weight reduction			
16	It is ones life style that makes one obese			
17	Taking a very light dinner helps to reduce obesity than skipping meals			
18	The energy requirement varies according to the age of the individual			
19	The fat in baked foods does not lead to weight gain			
20	Sugars should be used sparingly as it can cause weight gain			

	I think that…….PART II (A)	Yes	Doubtful	No
1 **A**	Parboiled rice is more nutritious than raw rice			
2	Baked foods have more caloric value than fried foods			
3	Bakery products can very well meet the nutritional needs of an individual			
4	Foods from street vendors are not hygeinic			
5	One should cook rice only by absorption method			
6	Skipping breakfast is not healthy			
7	Gooseberry contains more Vitamin C than an apple			
8	One should use homegrown green leafy vegetables for cooking to protect health			
9	Only rich people can afford to eat a balanced diet			
10	Pan chewing is very healthy for gums			
11	Reheating can purify the oil			
12	Smokers are never overweight or obese			
13	One should not be influenced by TV advertisements topurchase food items			
14	One should always buy only recognized and branded products			
15	Iodised salt consumption is not safe			
16	Daily intake of fruits is not practical.			
	I think that…… (B)	Yes	Doubtful	No
1	Overweight and obesity can lead to diabetes			
2	Obese people very strong and healthy			
3	It is difficult for the feet to carry overweight			
4	Nibbling in between meals is good for health			
5	Low birth weight can lead to many health problems			
6	Excess fat consumption may lead to heart problems			
7	Antioxidant intake is associated with risk of cancer			
8	Vegetarians are not more prone to nutritional deficiencies			
9	Daily use of vanaspathy is good for health			
10	Ghee should be taken regularly by adults to promote health			
11	A healthy person is always overweight			
12	Gaining too much weight is not dangerous to health			
13	Obesity will lead to major health problems			
14	Frequent skipping of meals can result in deficiency diseases			
15	Children should get atleast 8 hours of sleep for good health			
16	Eating leafy vegetables can lead to diarrhea			

	I think that…… (C)	Yes	Doubtful	No
1	Children should not spend time for play, exercise or physical activity			
2	It is always better to sleep or watch TV during free time			
3	It not usual for boys to be obese			
4	Vegetarianism is the correct way to obtain a healthy body weight			
5	Prevalence of overweight is increasing among children in Kerala			
6	Snacking during TV viewing leads to overweight			
7	Children are too busy to take proper food daily.			
8	An overweight person will have overweight/obese children			
9	Giving powdered (artificial) milk to the babies can make them healthy and strong later in life			
10	Nuts can be consumed daily in large quantities with out the fear of weight gain			
11	Skipping meals is essential for weight reduction			
12	Use of fried foods will lead to obesity			
13	Soft drinks aids in weight reduction			
14	It is good for health if you walk to school			
15	Taking an early light dinner helps in weight reduction			
16	Gaining too much weight is dangerous to health			

	PART III (A)	Yes	Doubtful	No
1	Bakery foods are frequently used at home			
2	While purchasing priority is given to nutritive value of foods.			
3	TV advertisements are considered for food purchase.			
4	I do not buy food products after their expiry date			
5	Milk is avoided as it makes me fat			
6	I drink soft drinks/colas usually than milk			
7	Fried items are prepared regularly at home			
8	I take ice cream regularly.			
9	I regularly eat food from outside			
10	I regularly eat bakery items for lunch			
11	I eat plenty of vegetable to maintain my health			
12	I drink atleast eight glasses of water daily			
13	I usually take a good effort every day to eat only healthy foods			
	(B)	Yes	Doubtful	No
1	I never skip any meals			
2	I eat plenty of leafy vegetables as they are rich in iron			
3	I have severe pain in joints since I am obese			
4	I always eat a heavy meal at night			
5	I do not like to nibble in between meals			
6	Boiled water with sugar and salt is taken when I get diarrhea			
7	I never go to bathroom while in school			
8	I have severe leg aches related to obesity			
9	I usually take a nap during break time at school			
10	I frequently get bleeding gums			
11	I became overweight because of constant eating of energy rich foods			
12	I always try to maintain a healthy weight			
13	Sweet items are consumed after meals			
	(C)	Yes	Doubtful	No
1	I usually spend holidays by watching TV and sleeping			
2	I actively participate in school games and sports.			
3	Pizzas, burgers, sandwiches, colas and sweets are my favourites			
4	I eat plenty of chocolates			
5	Milk and milk products are part of the daily diet.			
6	I eat only very little to prevent overweight			
7	Fried foods are totally avoided.			
8	I eat a variety of foods every day			
9	I prefer fish to meat			
10	Exercise is part of my everyday routines as it is very important for maintaining good health.			
11	I usually take a very light dinner for effective weight reduction			
12	I practice vegetarianism to lose weight			
13	I usually avoid lunch as it is the best way for weight reduction			