NUTRITIONAL ASSESSMENT OF OBESE PRESCHOOL CHILDREN (3-5 YEARS) AND THE ASSOCIATED FACTORS

By

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B.Sc. (Home Science)

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DECLARATION

I, **SAADIA KHAN,** hereby declare that the thesis entitled **"NUTRITIONAL ASSESSMENT OF OBESE PRESCHOOL CHILDREN (3-5 YEARS) AND THE ASSOCIATED FACTORS"** submitted to the **Acharya N. G. Ranga Agricultural University** for the degree of **Master of Science in Home Science (Nutrition and Dietetics)** is the result of the original research done by me. I also declare that no material contained in the thesis has been published earlier in any manner.

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CERTIFICATE

Miss. SAADIA KHAN has satisfactorily prosecuted the course of research and that the thesis entitled "**NUTRITIONAL ASSESSMENT OF OBESE PRESCHOOL CHILDREN (3 -5 YEARS) AND THE ASSOCIATED FACTORS"** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that neither the thesis nor its part thereof has been previously submitted by him/her for a degree of any University.

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This is to certify that the thesis entitled "**NUTRITIONAL ASSESSMENT OF OBESE PRESCHOOL CHILDREN (3-5 YEARS) AND THE ASSOCIATED FACTORS"** submitted in partial fulfillment of the requirements for the degree of Master Of Science In Home Science (Nutrition And Dietetics) of the Acharya N. G. Ranga Agricultural University, Hyderabad is a record of the bonafide original research work carried out by **Miss. SAADIA KHAN** under our guidance and supervision.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part and all assistance received during the course of the investigations have been duly acknowledged by the author of the thesis.

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LIST OF ABBREVIATIONS

%	:	Percent
mg	:	Milligram
gm	:	Gram
Kg	:	Kilogram
dl	:	deciliter
KJ	:	Kilojoule
Kcal	:	Kilocalorie
BMI	:	Body mass index
MUAC	:	Mid upper arm circumference
TSK	:	Triceps skinfold
IAP	:	Indian Academy of Pediatrics
AAP	:	American Academy of Pediatrics
et al	:	and other

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ABSTRACT

The prevalence of overweight and obesity appear to be increasing at an alarming rate. Pressures from the "obesogenic" environment are driving up obesity rates and it is observed that a large number of obese children maintain their obesity into adulthood when the risk of obesity-associated morbidity is much higher. Therefore an attempt was made to assess the nutritional status of obese preschool children and identify the associated factors of obesity among these preschoolers. The objective of the study was to assess the nutritional status of obese preschool children by anthropometric assessment and dietary assessment and identify the causative factors for childhood obesity and study the knowledge, attitude of mothers related to childhood obesity and find out the dietary practice followed by the mothers in regard to their children.

From the selected five private schools boys and girls of preschool age, 3-5 years were screened for BMI and 30 children with BMI >95th percentile were selected as obese children and 30 children with BMI between 25th - 50th percentile were selected as non-obese controls.

Nutritional status of preschool children was assessed by taking their height, weight, mid upper arm circumference and triceps skin fold measurements. Parent's BMI was assessed from their height and weight measurements. A three day- 24 hour diet recall survey on obese and non obese preschool children and their parents provided average food intake of each individual, from which proximate nutrients and energy intake was calculated. Mothers of non-obese and obese children were assessed for their knowledge, attitude and practices related to obesity in children using the questionnaire developed as part of the research work.

The demographic and socio-economic and cultural factors associated with obesity indicated that more number of girls compared to boys and more number of 4-5 year

old children compared to 3-4 year preschool children were found to be obese. The incidence of obesity among preschool children was high whose mothers had graduate level of education and were homemakers and fathers who had PG/professional level of education. All the obese preschool children belonged to nuclear family with a family size of < 4 members and medium size 5-6 members.

Mothers of obese children in general entered pregnancy with a greater body weight compared to non-obese group mothers. The incidence of obesity among preschoolers born under cesarean delivery was 1.7 times more than children born under normal delivery. Sixty three percent of obese children were born under cesarean delivery. In any birth order girls were found to be more obese than boys and more of first born children were obese compared to second and third born children. Seventy percent of the obese children had a birth weight of 3.0- 4.0 kg. Early introduction of supplementary foods among obese children has been observed. The higher percentage of commercial food supplements fed to the obese children laid foundation for obesity at infancy, which must have continued to preschool age. Majority of obese children were reared by the mothers unlike some non obese, who were taken care either by grandmothers or care takers.

Both boys and girls of obese category were taller (>50^{th} percentile) indicating the lack of association between stunting and obesity among preschoolers. There was a significant difference between the weights and BMI of non-obese and obese children, but triceps skin fold measurements of the preschool children showed similar trends in percentile distribution. The MUAC of obese boys and girls matched with 75^{th}, 90^{th} and 95^{th} percentiles of NHANES I. Irrespective of wide variation in body weight and BMI of both the groups the individual Mid upper arm circumference was found to be a determinant of BMI of obese children ($p<0.05$) after applying linear regressions equations.

The average height of parents of both the groups showed no significant difference. The weight was significantly high among mothers ($p<0.05$) and fathers ($p< 0.01$) of obese children compared to the mothers and fathers of non obese children. The BMI of mothers of non-obese was low ($p<0.05$) compared to mothers of obese preschool children. Fathers of obese children also had high BMI ($p<0.01$). Mothers (90%) and fathers (70%) of obese children were obese or overweight. BMI of mothers of non-obese children influenced their children's BMI ($p<0.05$) and the height of fathers of non-obese children influenced their children heights ($p<0.01$).

Obese children relatively had a very high intake of carbohydrate (251 $\pm$ 87 gm), protein (46 $\pm$ 11.8gm), fat (71.4 $\pm$ 18 gm) and a total energy intake (1857 $\pm$ 525 kcals) which were significantly high compared to non obese children. The percent calories consumed from carbohydrates, protein and fat showed no significant difference between the groups. Obese children of 3-4 years consumed on an average 184% more fat, 187% more protein, 96% more energy while, non obese also consumed 84% more fat,122% more protein, 10% more energy compared to recommended dietary allowances. The obese children of 4-5 years showed a high fat intake of 177% Vs 7% in non-obese, protein of 199% Vs 93% non-obese and 37% energy compared to age specific requirements. The carbohydrate intake of 3 -4 yr children strongly influenced their energy intake ($p<0.01$), whereas, carbohydrate and fat intake among the 4-5 year old obese children and only fat intake in non-obese children showed a strong influence on their energy intake ($p<0.01$). Results also indicated that anthropometric measurements of non-obese and obese children did not determine their energy intake. Though majority of fathers and mothers were found to be obese, their dietary intake, especially energy

and protein were found to be around 30- 34% less than the recommended dietary allowances.

Response to knowledge and attitude tests showed that mothers of obese children had better knowledge and attitude compared to mothers of non-obese children. The practice of consuming snacks several times a day, binging snacks while watching television, between meals and all the day was observed to be relatively high in obese children. Obese children spent longer hours sitting and watching television and more mothers of obese children didn't allow them to play outdoors. A marked difference was found in the readiness of non-obese children for physical activity compared to the obese children.

Attitudes and practices outweigh the role of parental knowledge in maintaining normal nutritional status of preschool children. Children of obese or over weight parents, the first born children, commercial supplements fed at infancy, ignoring binge habits in children, allowing passive TV watching, not allowing any outdoor physical play, feeding high calorie nutrients in quantities of two to three times more than requirements for their age were found to be the crucial factors in causing obesity among preschool children. Motivation and training of parents for acquiring skills of correct feeding and engaging the preschoolers in more physical play might be the solution.

CHAPTER I

INTRODUCTION

The world is facing a global epidemic of obesity. The overall incidence of overweight and obesity in preschool age children at all India level is reported to be 3.5 % and 1.5 % respectively, while being compared to 15.3% and 3.1% respectively in U.S (Martorell *et al*., 2000). Research that can inform effective early obesity prevention is key to reducing obesity among children and to reducing overall population prevalence of obesity.

Obesity in children is expressed in BMI percentiles. Since normal BMI ranges are lower in children and adolescents than in adults, the adult reference ranges should not be used. Instead, age and sex specific references data (percentile cut off points), which are found on growth charts, should be used.

A child with a BMI at 85^{th} or below 95^{th} percentile for age and sex is considered at risk of overweight, where as a child with a BMI at or above 95^{th} percentile is obese. Children with very high BMI are at greater risk of morbidity related to childhood obesity. Childhood obesity increases the risk of dyslipidemia, cardiovascular disease, impaired glucose tolerance, chronic inflammation, gall stones, non – alcoholic fatty liver disease, pancreatitis, many other musculoskeletal, neurological alterations and consequently the children are at higher risk of being obese as adults (Ekelund *et al*., 2006). The fact is that most obesity associated comorbities continues into adulthood. The need for treatment and prevention of childhood and adolescent obesity should be of a greater concern.

Among adults, personal responsibility plays a role in determining food choice, intake and weight status in obesogenic environment. In contrast, infants and young children are dependent on parents and care takers to provide food. Hence parents and care takers play a crucial role in structuring children's early eating habits and environment (Darcy *et al*., 2006). Included among the eating habits are consumption of high sugary and fatty foods, with a decrease intake of fiber (Kim *et al*., 1995), increased meal time (Jennifer and Tanya 2008), increased amount of food available and large portion size (Hollie *et al*., 2007), increased appetite (Susan & Jane 2008), increased

consumption of high fatty foods (Donna *et al*., 2004) and a heavy dinner on weekends (Maffeis *et al*., 2000). The role of physical activity in weight maintenance is very much evident. But nowadays it has become difficult for the children to be physically active. In schools, due to lack of physical education classes, less space for outdoor playing, the children have little chance for being physically active. Due to the digital lifestyle or limitations of outdoor space, children when are at home are usually watching TV, playing games on computer for long hours and hardly involved in any outdoor play. With the increase of such sedentary behavior, the risk of obesity also increases.

Children consume a substantial proportion of their daily energy intake while watching television and TV commercials, which typically promote high sugars, high fat, and processed foods and can, have a large impact on children's food choices. In addition, children who eat while watching television are less likely to pay attention to hunger and satiety cues and are therefore more likely to over eat (Susan & Jane 2008). Besides the obesogenic environment, there are some other variables which are associated with childhood obesity. Factors such as family history, high birth weight of the child (Q He *et al*., 2000), long sleeping hours, maternal employment, parental obesity (Birch & Davison 2001),their own food eating behavior with regard to time of eating, food selection, place of eating are correlated with the child's food behavior (Moria *et al*., 2004).

The rise in obesity increases the risk of numerous chronic diseases, which in turn increases medical cost to treat these diseases. The modest way to prevent is hypothesized to be possible only by finding out the factors leading to childhood obesity and tracing the reasons from parents nutritional status and lifestyle to the child's present obese status and then suggest corrective approaches for the child's eating habits, physical activity and lifestyle.

Based on this hypothesis, the present study, "NUTRITIONAL ASSESSMENT OF OBESE PRESCHOOL CHILDREN (3-5 YEARS) AND THE ASSOCIATED FACTORS" has been planned with the following objectives.

1. To identify the physical, physiological and lifestyle factors associated with obesity among preschool children.
2. To assess the knowledge, attitude, practice (KAP) of parents of obese and non obese preschool children on obesity related factors.

3. To compare the nutritional status and obesity associated factors of obese preschool children with non – obese preschool children.
4. To compare the nutritional status and obesity associated factors of obese and non-obese preschool children with their parents.

CHAPTER II

REVIEW OF LITERATURE

Obesity was once considered a problem of adults only in the high income countries but now dramatically it is on the rise in low and middle income countries, particularly in the urban settings, with its prevalence spreading among children and adolescents.

For the present study "Nutritional Assessment of Obese Preschool Children (3-5 Years) And the Associated Factors", the review of literatures is presented under the following heads:

2.1 Etiology and consequences of childhood obesity

2.2 Influence of nutritional factors on childhood obesity

2.3 Influence of child feeding practices on body weight

2.4 Influence of sedentary lifestyle

2.5 Early risk factors associated with childhood obesity

2.6 Parental obesity and relation to childhood obesity

2.7 Parent's perception about their child being overweight or obese

In beginning of the third year of the child till the end of the fifth year is considered as the preschool age. Children of this age are in such vulnerable state that they depend completely on their parents for their physical, nutritional as well as emotional needs. The increasing incidence of overweight and obesity among preschool children has been found to be 4.5% and 1.4% respectively in Semi urban South India (Harsha *et al.*, 2008), while screening 425 preschool children using new child growth standards by WHO. This alarming situation makes it necessary to investigate the underlying causes for childhood obesity.

In children and adolescents, BMI varies with age and gender. It typically rises during the first months after birth, falls after the first year and rises again around the

sixth year of life. The BMI percentile indicates the relative position of the child's BMI as compared with a reference population of children of the same age and sex.

According to WHO, a BMI above the 85th percentile is generally considered overweight and BMI above 95th and 97th percentiles is defined as obese and morbid obese respectively.

2.1 ETIOLOGY AND CONSEQUENCES OF CHILDHOOD OBESITY

2.1.1 Etiology of Childhood Obesity

The dramatic increase in the prevalence of the obesity among preschool children suggests the significant influence of the environmental factors and perhaps, peri-natal factors since it is not possible for the gene pool to change so dramatically in less than a generation (Cara *et al*., 2002 and Beatrice *et al*., 2007).The etiology of childhood obesity has the following factors which interact to create what has recently been described as an "obesogenic" environment (Hollie & Rena 2007 and Jago *et al.*, 2005).

1. Increased availability of a variety of low cost, energy dense foods
2. Increased portion size served
3. Increased consumption of high fat and high sugary foods
4. Increased consumption of sugary – sweetened beverages such as soft drinks and juices
5. Diet devoid of fruits and vegetables
6. Insufficient dairy consumption
7. Decreased physical education classes in schools
8. More of digital lifestyle, use of vehicles, escalators, elevators resulting in decreased physical activity

Besides these, peri-natal factors such as gestational diabetes, over and under nutrition during pregnancy may contribute to the development of childhood obesity. There is ample evidence from large, long term studies for a relationship between higher birth weight and increased fatness (Q He *et al*., 2000). In addition, over or under nutrition during pregnancy may elicit metabolic responses that can lead to childhood obesity. Data from mice models suggest that intrauterine exposure to elevated insulin

levels and early introduction of high carbohydrate formulas result in higher insulinemic state in infant mice that persists through adulthood (Srinivasan *et al*., 2003).

Other factors such as ethicinity, socio- economic status and the presence of overweight and obesity in parents have a great influence on body weight (Birch and Davison 2001) of children which need to be taken in to account. Individuals in the lower socio- economic classes and children of overweight and obese parents (Darcy *et al*., 2006) are more likely to be obese.

2.1.2 Complications of Childhood Obesity

Childhood obesity is a multisystem disease with potentially devastating consequences. As with adults, obesity in childhood caused hypertension, dyslipidemia, chronic inflammation, increased blood clotting tendency, endothelial dysfunction and hyperinsulinemia (Jennifer *et al*., 2004). This clustering of cardiovascular disease risk factor, known as insulin resistance syndrome, has been identified in children as young as 5 years of age (Deborah Young-Hyman *et al*., 2001).

Diabetes mellitus type II which once went undiagnosed in adolescence, is almost entirely attributable to the childhood obesity, though in later life stages, heredity and lifestyle factors affect individual risk (Jennifer *et al*., 2004).

Among obese children frequent pulmonary complications include sleep disordered breathing, asthma and exercise intolerance. Development of asthma on exercise in an obese child can limit physical activity and thus cause further weight gain (Adelman *et al*., 2001). Furthermore, serious hepatic, renal, musculoskeletal and neurological complications have been increasingly recognized among boys (Goulding *et al*., 2001). Findings of many studies indicate substantial psychological consequences of childhood obesity. Overweight children as young as age 5 years can develop a negative self image and obese adolescents show declining degree of self esteem associated with sadness, loneliness, nervousness and high risk behavior (Davison & Birch 2001 and Strauss 2000).

2.2 INFLUENCE OF NUTRITIONAL FACTORS ON CHILDHOOD OBESITY

Generally obesity is a consequence of a period of prolonged positive energy balance, when energy intake exceeds energy needs. The type of food eaten in the current modern diet is likely to be a contributing factor in the rise in obesity levels.

2.2.1 Carbohydrates

In a balanced diet, carbohydrates should typically provide approximately 60 – 65% of the total daily calories and consumption of fruits, vegetables, legumes, moderate – low fat dairy products, limited amount of refined grains and moderate amounts of whole grains should be considered for this. It is common for children to prefer other foods which are often rich in calories but not in other nutrients, like potato chips, ready to eat cereals, soft drinks, cakes, biscuits, pizzas etc. Such high glycemic foods will put the child at even more high risk of impaired glucose tolerance, type II diabetes, hyperlipidemia and hypertension (Toeller *et al*., 2001).

Consumption of high glycemic index foods increased post prandial blood glucose concentrations (Foster and Miller 1995) played a major part in increasing appetite and increasing consumption (Ebbeling & Luding 2001). A high glycemic diet has been linked with risk for central adiposity (Toeller *et al*., 2001), cardiovascular disease (Liu *et al*., 2000) in adults.

2.2.1.1 Increase in Soft Drink and Beverage Consumption: In recent years, soft drinks have been targeted as a culprit in the rates of childhood obesity. Consumers of soft drinks take on an average 188 calories per day from soft drinks than non consumers (St. Onge *et al*., 2003). Sugar sweetened soft drinks might promote energy intake and excessive weight gain because of their high glycemic index or become compensation for calories consumed in liquid form is less than complete than for calories consumed in solid form. In a study conducted by Harnack *et al.* (1999) the highest soft drink consumption category consumed less milk and fruit juice compared to those in the lowest consumption category (non consumers) and shown a positive association to obesity with an increased over all total daily intake.

Secondary to consumption of soft drinks, 100% fruit juice and sweetened fruit drinks have received considerable attention as potential sources of high energy beverages that could be related to the prevalence of obesity among young children.

The pattern of fruit juice consumption has changed overtime. Fifty years ago, orange juice was the major juice produced and it was consumed primarily to prevent scurvy. In the current era, apple juice has become the choice of less than 5 yr of age group. Though fruit juices are considered as healthy, low fat nutritious beverages, excess consumption has been reported as a contributing factor to decreased stature, increased

caloric intake and obesity (Dennison, 1996). In contrast, milk, a low glycemic index beverage seems to protect overweight young adults from becoming obese (Pereira *et al.*, 2002).

2.2.1.2 Decrease in Dairy Consumption: Concomitant with the increase in fruit juice, soft drink consumption, there has been a decline in milk intake. Studies of newborn infants and preschool aged children have demonstrated a preference for sweet tasting foods and beverages (Dennison, 1996).

Recent studies have shown an inverse association between frequency on milk consumption and body mass in children (Barba *et al*., 2005). Decrease in milk consumption is of concern as it is a major dietary source of calcium, and is essential for growth and proper development in the young children (Dennison *et al.*, 1997) and decreased calcium during the growing age may stunt the height of child and indirectly promoting obesity.

In addition to being an essential macro mineral for growth and development, dietary calcium has been associated with body weight regulation. Recent human and animal studies indicated that a higher calcium intake was associated with reduced body fat or less gain of body fat over time. In a study of adipose cells in transgenic mice, high calcium, medium dairy and high dairy diets reduced lipogenesis, stimulated lipolysis and reduced body weight accumulation at equivalent levels of energy intake (Zemel *et al*., 2000). Longitudinal study on preschool children (24 – 60 months), with higher intake of calcium, mono unsaturated fat and increased servings of dairy products were associated with lower body fat (Carruth and Skinner, 2001). The latest recommended dietary allowances for Indians were reported by the ICMR Expert Group 2009 and the recommendation for children from 1-9 year was 600mg/dl which is equivalent that of adult man or women.

2.2.2 Fats

It is evident that the deposition of excess adipose tissue results from a positive energy balance (Westerterp *et al*., 1996). It appears, in particular the proportion of fat ingested, compared with carbohydrates and protein, influences the amount of body fat. The greater energy density of lipids (38 KJ/g as compared to 17 KJ/g for the other macronutrients) may be one way in which fat exerts its obesity promoting effect. Thus, a higher fat diet necessarily results in a higher energy intake, which leads to a positive

energy balance if energy expenditure isn't increased proportionately. This can be seen in the study of Westerterp *et al*, (1996) who found that the fat content of the diet had an effect on body fat mass only as a function of its alteration of energy intake.

In children, however, the evidence is inconclusive, some studies found a positive relation between fat intake and body fat (Tucker *et al.*, 1997 and Maffies *et al*., 1996), where as some other studies did not (Davies 1997). There was no correlation found between diet composition and body size in a large sample of children (n =1444) aged 1.5 – 4.5 years (Davies, 1997), where age and sex adjusted BMI was used to assess body size.

Attempts to associate diet composition to body composition found no relation between dietary intake of total energy, fat, carbohydrates or protein with body fat percentage in children. Oxygen – 18 dilution methods was used to calculate percentage body fat and a 4 – day weighed food record was used to determine intakes of total energy and energy from each macro nutrient. It was concluded that the relation between fat intake and body fat may develop overtime and may not be evident in preschool children. Energy expenditure, in particular physical activity level, may have a greater influence on body composition in early childhood (Lisa and Peter, 2000).

2.3 INFLUENCE OF CHILD FEEDING PRACTICES

To enhance the nutritional quality of children's diet, an understanding of the factors that influence children's food preferences is essential, children eat what they like and leave the rest, their food preferences are major determinants of food consumption patterns, and current evidence has begun to reveal that preferences are linked to dietary patterns, which in turn influence the risk for obesity and other chronic diseases.

2.3.1 Diet Composition

The type of food eaten in the modern diet is likely to be a contributing factor in the rise in obesity levels. Energy dense foods such as fatty and sugary foods and drinks seem to affect satiety and food consumption.

According to Gibson, (2000), it is not only the fat which is inversely related to positive energy balance but also a range of starchy and sugar foods, including breakfast cereals, bread, potatoes, confectionery and sugar preserves. In his findings, the children

(n = 1675) with the least energy dense diets consumed significantly more soft drinks which raised the possibility that the consumption of soft drinks explained part of the observed inverse relationship between energy density and sugars in the total diet. When energy density was recalculated to exclude the contribution of soft drinks, it remained inversely correlated with total sugars ($r = -0.20$; $p < 0.001$) and positively correlated with starch ($r = 0.24$; $p < 0.0001$).

As the carbohydrate stores are limited in the form of glycogen, over feeding beyond this point may result in the metabolism of excess carbohydrates being converted to fat. Therefore with such positive energy balance, fat intake is an important contributor to obesity.

The dietary fat plays a role in the development and treatment of obesity as the energy provided by 1 gram of fat is 9 kcals when compared to 4 kcals which are yielded from 1 gram of carbohydrate. The excess intake of such energy dense foods can result in positive energy balance. And unfortunately with the body having a poor auto – regulatory metabolic system for fat, it ends up with storing almost unlimited quantity of fat as adipose tissue. Turker *et al.*, (1997) from Brigham Young University in Provo, Utah along with his colleagues attest that excess energy intake from fat is positively related to adiposity.

Thus, a total reduction in the excess intake of fat and carbohydrate can reduce the gap between total energy intake and total energy expenditure.

2.3.2 Portion Size

Despite the widespread commercial trends toward large portions, there is little research into the effects of portion size on food intake.

In a study, where 109 preschool children were given lunches that contained small, medium, or large amounts of macaroni and cheese, and in whom voluntary energy consumption was measured, younger children (mean age 3·6 years) irrespective of portion size consumed more energy when given a large versus a small portion compared to older children (5·0 years). These findings suggest that, as children grow older, they become less responsive to internal hunger and satiety cues and more reactive to environmental stimuli (Rolls *et al.*, 2000).

2.3.3 Hunger Cues and Food Intake

Research findings on "Behavioral susceptibility theory of obesity" concludes that satiety responsiveness and food cue responsiveness are related to adiposity as early as 3 years of age suggesting that over time these traits could contribute significantly to lifetime risk of obesity (Susan & Jane 2008).

Associating child's eating behavior, satiety responsive, food cues responsiveness to the parents of 8-11 yr olds (n = 10,364) and 3-5 year olds (n= 572) to the BMI of children showed that the children of higher weight and waist categories had lower satiety responsiveness (8 –11-y-olds: *r*_0.22; 3–5-yolds: *r*_0.19; *P* _0.001) and higher food cue responsiveness (*r*_ 0.18 and 0.18; *P* _0.001. And their effect was more strongly linear.

2.3.4 Consumption of Fast Foods

The rise in consumption of fast food, in developed and developing nations, might have particular relevance to the childhood obesity epidemic.

Results of several studies, (Binkley *et al*., 2000 and French *et al*., 2001) suggest an association between fast-food consumption and total energy intake and bodyweight in adolescents and adults. Although there is no data on fast food consumption and obesity in children, adolescent girls who ate fast food four times a week or more consumed about 185–260 per day more than those who did not (McNutt *et al.,* 1997).

2.3.5 Palatable Food Restriction and Food Intake

Currently, young children's intakes of dietary fat and sugar are high as they tend to be more palatable and readily acceptable, whereas their intakes of fruit and vegetables are well below recommended amounts. Restricting children's access to foods high in fat and sugar by parents may appear as the only straightforward method to them for promoting healthy eating patterns. Wardle, (1990) observed that there were "few studies which actually demonstrate that so-called 'forbidden' fruit is more tempting".

Several studies indicated that restricting access to foods may increase children's preferences (Birch *et al*., 1980, Lepper *et al*., 1982 and Jennifer and Birch, 1999) and intake of restricted foods (Fisher JO and Birch LL., 2000) while diminishing self-control in eating (Mischel & Ebbesen 1970).

Thus restricting access can sensitize children to external eating cues while increasing their desire to obtain and consume the restricted food.

2.4 INFLUENCE OF SEDENTARY LIFESTYLE

Today's environment shows an inactive lifestyle that is likely to contribute to positive energy balance and childhood obesity. Whether a child or adolescent, the evidence is conclusive that physical activity is conducive to a healthy lifestyle and prevention of various diseases.

The number of inactive hours spent by the children to while away their time such as watching television and playing computer games has both been associated with obesity, particularly in children. Television may also influence eating behavior, either indirectly, through advertisings for fast and junk food or directly by increasing snack consumption.

2.4.1 Television Viewing and Food Intake

Television viewing, apart from promoting sedentary behavior, it also has a negative impact on the dietary habits of the kids. The American Academy of Pediatrics (AAP) has recommended that pediatricians advise parents to avoid television-viewing entirely for children who are younger than 2 years keeping in view the negative impact. In a survey study done by Elizebeth *et al.,* (2007), a questionnaire designed to investigate the child's physical activity was filled up by parents of children aged 0 – 6 years (n = 1051), showed that 75% of the children (excluding 0 – 2 years old) watched television for more than 2 hours and 35% of the children watched DVD/s/ videos for approximately 1 hour and 20 minutes, on an average.

Children consumed approximately 26 % of their total dietary intake while watching television and much of the energy came from the snacks and not meals. It was also shown that children who consumed more calories from fat while watching television had higher BMIs (Donna *et al*., 2004). In addition, children who ate in front of the television were less likely to pay attention to hunger and satiety cues and were therefore more likely to overeat (Susan & Jane 2008).

2.4.2 Lack of Physical Exercise

With more and more of lifestyle getting digital, the amount of physical activity is decreasing. The children in the schools are restricted to be in their classrooms due to the

hectic learning hours all through the day, barely getting time for free play. With the lunch hour being for about 30 - 40 minutes, they hardly get time left after they finish their lunch. Moreover the activities preferred in the schools these days are indoor activities, partly because of the minimum space available in the school for free play. At home, the children after coming back from school usually prefer to sleep and then in the evenings they spend their time by either watching television or playing any indoor game. Ekelund *et al*, (2005) showed a relation between less physical activity and body fat mass. He resolved that physical activity was independently associated with fat mass in males but not in females. The data also showed an intergenerational association of fat mass between mothers and daughters but not mothers and sons.

2.5 EARLY RISK FACTORS ASSOCIATED WITH OBESITY

Evidence on early risk factors for childhood obesity is limited at present, although awareness is increasing for the importance of the environment in early life. Almost all recognized risk factors are potential rather than confirmed. A cohort study done by John.J.Reilly *et al*, (2005) suggests possible six early risk factors, given below.

Intrauterine and perinatal factors: Increasing birth weight was independently and linearly associated with increasing prevalence of obesity at age 7.

Infant feeding and weaning practice: The apparent protective effect of exclusive breastfeeding on obesity at age 7 was considered together with the other infant feeding and weaning practice. In the final model of the study, timing of introduction of complementary feeding was not significantly related to the risk of obesity at age 7.

Family characteristics and demographics: When only one parent was obese, the risk of obesity at age 7 was increased. The risk was higher when both parents were obese

Sleep: Sleep duration in children aged 30 months was independently associated with prevalence of obesity at age 7.Children in the lowest two quarters of sleep duration (< 10.5 hours and 10.5-10.9 hours) were more likely to be obese at age 7 than children in the highest quarter (> 12 hours).

Sedentary behavior: The odds ratio for obesity increased linearly as the number of hours of television viewing increased. For children reported to watch television for 4-8 hours per week at age 3 the adjusted odds ratio for obesity at age 7 was 1.37 (1.02 to 1.83). For those reported to watch more than eight hours per week the adjusted odds ratio was 1.55 (1.13 to 2.12).

Dietary patterns: No conclusive evidence of an association between dietary patterns at age 3 and risk of obesity at age 7. A junk food type dietary pattern at age 3 was significantly associated with risk of obesity at age 7, although the association only just reached significance at the 10% level in the final model.

2.5.1 Maternal Employment

In most of the developed countries, maternal employment has been increasing rapidly. Changing patterns of family life has also been suggested to be contributing to the rising prevalence of childhood obesity.

In another cohort study where 13113 children aged 3 years were selected. Their heights and weights were taken and their BMI was calculated respectively. Their secondary objective was to accumulate the parental employment histories. The finding of the study were that of about 23% (3085) of children were overweight at 3 years and any maternal employment after the child's birth was associated with early childhood overweight (Summer *et al.,* 2008).

2.6 PARENTAL OBESITY

Now that the role of genetic factors in obesity is widely accepted, parental obesity can therefore be used as a marker of a higher genetic risk of obesity for young children.

Children of obese parents have more than 5 times the risk of children of normal-weight parents of becoming obese in adult life (Lake *et al*., 1997).

Whitaker *et al.*, (1997) sum up their findings as "Obese children under three years of age without obese parents are at low risk for obesity in adulthood, but among older children, obesity is an increasingly important predictor of adult obesity, regardless of whether the parents are obese. Parental obesity more than doubles the risk of adult obesity among both obese and non obese children less than 10 years of age".

2.7 PARENT'S PERCEPTION ABOUT THEIR CHILD BEING OVERWEIGHT AND OBESE

Parents who do not recognize weight problems in their children are less likely to take steps to change their children's unhealthy lifestyles and to prevent obesity. Making parents aware that obesity is a health problem might be the first step in promoting a healthy lifestyle and a healthy body weight among school-aged children. Although there is no direct evidence that increasing parents' awareness of children's weight problems would prevent overweight and obesity in children, there is evidence that parents' awareness and monitoring can prevent risky behavior among children and adolescents (Noor *et al*., 2008 and Wilma & Johannes 2006).

CHAPTER III

MATERIALS AND METHODS

The present study on "Nutritional assessment of obese preschool children (3-5 Years) and the associated factors" was undertaken to assess the nutritional status of obese preschool children and their parents while comparing it to the nutritional status of non obese preschool children and their parents. The work also involved study of Knowledge, Attitude and Practice (KAP) towards the various factors associated with obesity in preschool age group (3-5 years). The methodology used for this study is described under the following heads.

3.1 Selection of schools and selection of obese and non-obese preschool children

3.2 Nutritional assessment of children and their parents.

3.3 Testing the knowledge, attitude and practice of mothers of obese and non- obese preschool children.

3.5 Analysis of data.

3.1 SELECTION OF SCHOOLS AND SELECTION OF OBESE AND NON-OBESE PRESCHOOL CHILDREN

Five private schools were randomly selected within 5 km of radius from the centrally located College of Home Science, Hyderabad. A total of 223 preschool children between the age 3-5 years from Nursery and Lower Kindergarten sections of the selected schools were screened for their BMI to classify them as obese and non-obese.

BMI was calculated from height and weight measurements using the formula

$$BMI = \text{weight (kg's)} / \text{height (meters}^2\text{)}$$

and plotting the BMI on age and sex specific BMI percentile graph redesigned by Indian Academy of Pediatrics for boys (appendix A) and girls (appendix B) separately.

Of the screened children 30 obese, 19 girls and 11 boys and 30 non-obese preschool children, 15 girls and 15 boys were selected on obtaining consent from their parents to be a part of research work.

The school teachers, principal and parents of the selected children were briefly informed about the purpose of the study which helped getting their desired cooperation.

The anthropometric measurements of the preschool children were taken in the school while the parents were approached at their respective residences to record their anthropometric measurements.

3.2 NUTRITIONAL ASSESSMENT OF CHILDREN AND THEIR PARENTS

3.2.1 Anthropometric Assessment

The anthropometric measurements height, weight, mid-upper arm circumference and triceps skin fold measurements were taken for children and parents.

Height: Height was measured with a vertical measuring rod (anthropometry) while the subject stood erect without shoes, with heels and toes close together. The anthropometric rod was placed on the left side of the subject the investigator held the head of the subject in the so called Frankfurt horizontal plane by holding the chin with left hand and the occiput with the right little finger. The moving head piece of the anthropometer was placed with sagital plane over the head of the subject applying a slight pressure to reduce the thickness of hair. The reading was recorded to the nearest 0.1 cm, while the anthropometer rod was still in position.

Weight: The weight was taken using an electronic digital weighing scale. The subjects were made to stand erect without their footwear with their hand at their sides.

BMI: Body mass index also called as the quetelet's index is the ratio of weight (kg) / height (m^2)

$$BMI = \text{weight (kgs)} / \text{height}^2 \text{ (meters)}$$

The calculated BMI for each child was plotted in the age and sex specific BMI percentile graphs redesigned by Indian Academy of Pediatrics for boys and girls separately.

BMI for parents was calculated using the above equation and they were classified based on revised classification by (Misra *et al*., 2009) for Indian.

The revised BMI index is:

Normal BMI – 18.0 – 22.0 kg/m^2

Overweight - 23.0 – 24.9 kg/m^2

Obesity - >25 kg/m^2

Triceps skin fold measurements: The measurement of the tricep skin fold is performed at the midpoint of the upper left arm, between the acromion process and the tip of the olecranon with the arm hanging relaxed. To mark the midpoint, the left arm is bent 90° at the elbow, the forearm is placed palm down across the body. Then the tip of the acromion process of the shoulder blade at the outermost edge of the shoulder and the tip of the olecranon process of the ulna are located and marked. The distance between these two points is measured with a soft pen. The left arm is then extended so that it is hanging loosely by the side. The investigator grasps a vertical fold of skin plus the underlying fat, 1 cm above the midpoint. The skinfold is gently pulled away from the underlying muscle tissue and then the calipers jaws (Harpeden skinfold calipers) are applied exactly at the midpoint marked and the measurement were taken.

Mid upper arm circumference: Mid upper arm circumference was measured using a flexible, non-stretch tape. The subject was asked to stand erect and sideways to the investigator, with the head in the Frankfurt plane, arms relaxed and legs apart. The measurement was taken at the midpoint of the upper left arm between the acromion process and the tip of the olecranon. The tape was wrapped gently but firmly around the arm at the midpoint, care being taken to ensure that the arm is not squeezed.

3.3.2 Diet Survey

A three day food intake record was obtained through 24 hour diet recall method, wherein the first day data was collected by the investigator herself and the next two days data was recorded by the subject themselves. Average food intake of three days was calculated.

Since the individual shares from the total cooked amount of each preparation for the family as a whole, information was obtained specifically from the child, mother and the father. A set of standardized cups and spoons of varying sizes, measuring jar and measuring scale was used to measure the total cooked food intake of the individual. Data on various preparation and the raw materials used in it were obtained.

Based on the food intake record, nutrient intake was calculated using tables of Nutritive Value of Indian Foods (Gopalan *et al*., 2009). Proximate nutrients carbohydrates, protein and fat intake and total calories intake were calculated from the amount of each food consumed. Percent calories obtained from each of the proximate nutrients were calculated from the total calories.

3.4. ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICES

Mothers of non-obese and obese children were assessed for their knowledge, attitude and practices related to obesity in children using the questionnaire developed as part of the research work. The questionnaire is given under annexure C.

3.4.1 Knowledge

The questionnaire related to knowledge consisted of 30 questions with multiple choice answers which were filled up by the mothers of the obese and non-obese children. They were asked to tick the correct answer in their view. Each correct answer was given a mark and the scores obtained were recorded for each respondent.

3.4.2 Attitude

Twenty one attitude statements were framed consisting of both positive and negative statements. Responses were obtained on a five point continuum. Depending on the attitude scores subjects were divided among three categories as those with unfavorable

attitude, neutral attitude and favorable attitude. Responses categorization was done as follows:

No. of maximum statements:	21
Number of categories:	3
Difference between maximum:	(21 X 5) – (21 X 1)
and minimum score	= 105 – 21= 84
Factors to be used for categorization:	= 84/3 = 28
of attitude scores	
Unfavorable attitude range (UFA):	minimum score + factor
	21 + 28 = 49 → 1—49
Neutral attitude range (NA):	50 + 28 = 77 →50—77
Favorable attitude range (FA):	78 + 28 = 105 →78—105

3.4.3 Practice

A questionnaire was developed to collect information related to practice based on general dietary habits, child's food preference and physical activity including lifestyle

3.5 ANALYSIS OF DATA

The anthropometric and nutrient intake data obtained through the questionnaire were classified and tabulated for statistical analysis. Mean and standard deviation of the anthropometric data, total energy and macro nutrients intake were calculated. The data was analyzed using Z test and multiple linear regressions statistics.

CHAPTER 4

RESULTS AND DISCUSSION

The present study "Nutritional Assessment of Obese Preschool Children (3-5 Years) and the Associated Factors" was aimed to study the causative factors associated with obesity in the preschool children and compare the nutritional status of these obese preschool children and their parents with non obese preschool children and their parents and evaluate knowledge, attitude and practices (K-A-P) of parents of both the groups.

The nutritional assessment of obese and non obese children and their parents was assessed using anthropometric measurements and a 3 day dietary recall method and the etiological factors for their obesity were investigated using a structured questionnaire related to the family demographic, socio economic, physical, physiological conditions of parents, child's behavior towards food, child's activity, mothers knowledge, attitude and child's feeding practices.

The results of this study are presented under the following heads:

4.1 Demographic and socioeconomic factors associated with obesity in preschool children

4.2 Physical and physiological parameters of non-obese and obese preschool children and their parents

4.3 Nutritional assessment of non-obese and obese preschool children and their parents

4.4 Knowledge –Attitude –Practice of mother's of non-obese and obese preschool children on obesity related factors

4.1 DEMOGRAPHIC AND SOCIOECONOMIC FACTORS ASSOCIATED WITH OBESITY IN PRESCHOOL CHILDREN

The causes of obesity among preschool children could be traced back to several demographic, socioeconomic and cultural factors of the family. From the selected five private schools boys and girls of preschool age, 3-5 years were screened for BMI (redesigned by Khadhilkar *et al*., 2007, Indian Academy of Pediatrics) and thirty children with BMI > 95th percentile were selected as obese preschool children. Thirty children with BMI between 50-25th percentiles were selected as non-obese controls. Both the groups were selected after taking consent from their parents through the school administrators and parent's willingness to be a part of the study was also ascertained.

4.1.1. Age and Gender of the Non-obese and Obese Preschool Children

The percent distribution of the selected non-obese and obese preschool children under age and gender classification is given in table 4.1. Fifty percent of the non-obese group was boys and the rest of the 50% were girls and 40% were in the 3-4 years age group and 60% were in the 4-5 years age group. From the obese group 36% were boys and 64% were girls with 20% of them between 3-4 years age group and 80% between 4-5 years age group. More number of girls compare to boys and more number of 4-5 year old children compared to 3-4 year old preschool children were found to be obese indicating that girls have a greater tendency to become obese during preschool age and

Table 4.1. Distribution of non-obese and obese preschool children under age and gender classification

Age	Non-Obese children (n=30)		Obese children (n=30)	
	Boys	Girls	Boys	Girls
3-4 yr	20 (6)	20 (6)	3 (1)	17 (5)
4-5yr	30 (9)	30 (9)	33(10)	47(14)
Total	50	50	36	64

Values are percent figures
Figures in parenthesis indicate number of subjects

preschool age between 4-5 years seem to be promoting obesity. After the bouncing growth in infancy the growth in general is very slow during the second and third year of childhood. Preschool age once again promotes as the child understands ability increases, starts learning to eat, going to preprimary school and also becomes capable of being choosy.

Six percent of girls (n= 2176) were found to be obese against 3.1% of boys (n= 2231) in a study conducted in Sweden (Blomquist and Bergstrom, 1996). Similar results were reported in Kuwait as 18% of girls (n=635) and 16.1% of boys (n=645) in the preschool age were obese (Ezzat Amine and Fawzia 1996). Van Rossen *et al*, (2010) reported that childhood obesity presumably emerges after the age of 3 years.

These studies also indicate that the prevalence of obesity is more in female children compared to male children. An epidemiological study conducted by Navdeep Kaur *et al* (2010) in Amritsar, Punjab, India reported an average of 2% prevalence of obesity in both boys and girls independently from a total of 1745 preschool children, while 50% each of boys' girls showed not much difference between the genders.

4.1.2 Socio-Economic and Cultural Profile of Parents of Non-obese and Obese Preschool Children

The socioeconomic parameters like education, occupation and income and the cultural practices like family type, family size and dietary habits have a great influence on nutritional status of the children and these factors have been enumerated from the questionnaire given to the parents and the details are tabulated in table 4.2.

Nearly 45% each of mothers of non-obese children were graduates or PG/ professional, while 60% of mothers of obese children were graduates and 23% were either PG/professional. The educational level was below graduation i.e. Intermediate for 10% and 17% of mothers of non-obese and obese children respectively.

Nearly 53% and 40%of fathers of non-obese and obese children respectively had education up to graduation, 37% and 53% fathers of non-obese and obese children respectively had PG or professional education while 10% and 7% of fathers of non-obese and obese children respectively had intermediate education.

Results indicate that more children of mothers with graduate education and fathers with PG or professional education were obese compared to mother with professional or PG education or father's graduate level. At a low level of education as intermediate among mothers, the incidence of obesity increased compared to that of same education among fathers.

Table 4.2. Socio-economic and cultural profile of parents of non-obese and obese preschool children

Character	Details	Mothers of NOb PSC (n=30)	Mothers of Ob PSC (n=30)	Fathers of NOb PSC (n=30)	Fathers of Ob PSC (n=30)
Education	Intermediate	10	17	10	7
	Graduation	47	60	53	40
	PG/Professional	43	23	37	53
Occupation	Physician/MD	-	7	3	20
	Business	-	10	17	30
	Lecturer/Teacher	17	17	-	3
	Private Service	23	-	27	23
	Builder/ Civil Engineer	-	-	23	10
	Govt.Service	-	-	7	7
	IT Field	7	-	23	7
	Homemaker	53	67	-	-
		Non-obese group		Obese group	
Family Income (Rs)	Up to 20,000/-	3		10	
	20,000-50,000/-	67		67	
	50,000-1 lakh	23		17	
	Above 1 lakh	7		7	
Family type	Nuclear	80		100	
	Joint	20		-	
Family size	Small (<4)	33		67	
	Medium (5-6)	60		33	
	Large (> 6)	7		-	
Dietary habits	Non-vegetarian	93		86	
	Vegetarian	7		7	
	Ovo-vegetarian	-		7	
	Father's alcoholism	20		27	
	Mothers alcoholism	13		3	

Values are percent figures
NOb PSC: Non-obese preschool children
Ob PSC: Obese preschool children

In general mothers play an important role in feeding the children at home and in schools where as fathers have a major role in eating out habits. Fathers with higher professional education have tendency to bring in educational affluence and may influence the feeding patterns of children. Mothers with intermediate or graduate level of education were quite often found to be more enthusiastic and conscious in feeding their children and also show lot of interest in learning health tips and new recipes from different media which could have a major influence on the child's body weight. Inverse association between mother's educational level and childhood obesity after the age of 3

years has been reported by Van Rossen *et al*, (2010). The observation from the present study also confirm this relation of lower the mothers education higher the incidence of obesity among preschool children.

A greater percent of children whose mothers (67%) were not occupied in any active employment but are homemakers were obese against 53% of mothers who were also homemakers with non-obese children. Children of mothers who were in teaching profession as a teacher in school or lecturer in college, 17% each equally influenced the children being obese or non-obese. In general children of mothers occupied in business and medical profession (17%) were also found to be obese compared to mothers occupied in private service and IT field (30%) from which groups no child was reported to be obese. Father's occupation influenced the nutritional status of children in a varied manner. Children of fathers in business (30%), practicing physician (20%) and employed in private service (23%) were obese while fathers employed as civil engineer or involved in real estate (23%), those in IT field (23%) and in private service (27%) had children who were normal and non-obese.

The high incidence of obesity among preschool children whose mothers were homemakers could be due to the amount of time that mothers can spend for the child for cooking variety food and for feeding the child. Mothers involved in business, teaching or other profession would access more easily available ready to eat foods, which are often energy dense. Fathers involved in business, private service or medical profession may offer more money to the family for day to day purchases of energy rich foods. Saluja *et al*, (2010), illustrated no significant association between nutritional status of children and parents education and occupation, contradictingly a robust link to obesity in children was reported to be associated with the affluence of parents (Oliveira *et al.*, 2007 and Raghav Gaiha *et al*, 2010).

Equal percent of non-obese and obese preschool children, 67% each were found to be under a moderately high income between Rs 20,000- 50,000/- per month. Under lower middle income 3% of non-obese and 10% of obese preschool children were found. Nearly 30% of the non-obese and 24% of the obese preschool children belonged to a family income group of 50,000 – 1 lakh or above. Though family income has been reported to be one of the most influencing factors on the child's nutritional status, in the present study the preschool children nutritional status doesn't seem to be influenced by the family income as compared to the other studies, probably due to small sample size

which could not reflect the income variations on child's nutritional status. Supporting studies confirm that low family income significantly raise the risk of obesity in preschool children (Richard and Judith, 1999). Oliveira *et al.*, (2007), Raghav Gaiha *et al.*, (2010) and Van Rossen *et al* (2010) have also reported inverse association between family income and childhood obesity.

The cultural factors such as family type, family size and dietary habits as shown in table 4.2. showed influence on the child's nutritional status where in 100% of obese preschool children belonged to nuclear family with a family size of less than four members (67%) and medium size with 5-6 members (33%). Family size with 5-6 members had 60% of preschool children to be non-obese and 33% to be obese indicating that as the size of the family increases the prevalence of obesity among children is low. The smaller the family the larger the prevalence of obesity as more resources in terms of income, food and recreation are available. The prevalence of nuclear families has increased over the past two- three decades. With this, the present day families are self sufficient and there is an extravagancy in the family on food, with frequent consumption of special foods both at home and outside.

Nearly 93% of non-obese children and 86% of obese children had a family practice of taking non-vegetarian food while 7% each of non-obese and obese groups were vegetarian and 7% of the obese were ovo-vegetarian. Per say non-vegetarian food is not an obesity promoting factor the fat, but in the meat and the amount of fat added while cooking fleshy foods is more of more concern. Since children are usually served with tender meat, quite often it may not be a factor causing obesity among children specially the preschool age. More number of fathers (27%) and 3% of mothers of obese children were found to be alcoholic, while 20% of fathers and 13% of mothers of non-obese children also exhibited similar practices. Most of these parents in both the groups were also found to be obese. Kromhout (1983) reported three times high prevalence of obesity among men who drink at least one alcoholic drink per day compared to non-alcoholics.

4.2 PHYSICAL AND PHYSIOLOGICAL PARAMETERS OF OBESE AND NON-OBESE CHILDREN AND THEIR PARENTS

The physical and physiological status of parents of non-obese and obese preschool children in terms of their age, age at marriage, history of obesity and incidence of metabolic and other health complications is given in table 4.3.

Table 4.3. Physical and physiological history of parents of non-obese and obese preschool children

S.no	Factors	Mothers of NOb PSC (n=30)	Mothers of Ob PSC (n=30)	Fathers of NOb PSC (n=30)	Fathers of Ob PSC (n=30)
1	**Age , years (Mean ± SD)**	30.2 ± 3.38	32.6 ± 4.35	36.1 ± 2.90	36.8 ± 3.98
		z value = 2.45*		z value = 0.78^{NS}	
2	**Age at Marriage (years)**	23.2 ± 2.81	23.0 ± 3.51	28.63 ± 2.48	27.56 ± 3.01
		z value = -0.24^{NS}		z value = -1.52^{NS}	
3	**History of obesity (% of parents)**				
(a)	During childhood	37	53	13	33
(b)	Before marriage	33	53	-	27
(c)	After marriage	33	57	30	40
4	**Incidence of metabolic / other health complications (% of parents)**				
(a)	Hypertension	3	3	7	7
(b)	Diabètes mellites	3	3	-	10
(c)	Juvénile Diabètes mellites	-	3	-	-
(d)	Hypothyroidism	-	3	-	-

Significance Level --z-value - *-$p<0.05$ ^{NS} Non-significant

The mean age of mothers of obese children 32.6 ± 4.35 years was significantly higher ($p< 0.05$) compared to that of mothers of non-obese children 30.2 ± 3.38 years. No significant difference was observed between the age of fathers of non-obese children, 36.1 ± 2.90 and obese children 36.8 ± 3.98 years. The mean age at marriage of mothers (23 years) and father (28 years) of both non-obese and obese children didn't show any significant difference in the respective parent category. Fifty three to fifty seven percent of mothers of obese preschool children have reported that they were overweight or obese during childhood, before marriage and after marriage, while 33% to 37% of mothers of non-obese children reported to be overweight or obese during childhood, before marriage and after marriage. Thirty three percent of fathers of obese

children and 13% of fathers of non-obese children reported that they were overweight or obese during childhood, while only 27% of father's of obese children and none from fathers of non-obese children reported that they were neither overweight nor obese before marriage. After marriage 40% and 30% of the fathers of obese and non- obese preschool children respectively reported to have maintained overweight or obesity.

More number of mothers compared to fathers was found to be obese in both groups and large numbers of mothers in the non-obese group compared to the respective fathers were overweight or obese during childhood and before marriage. After marriage, both mothers and fathers of non-obese children maintained obesity in equal numbers. The incidence of obesity increased in fathers of both the groups from prior to marriage to after marriage. The association of the onset of obesity among children could be traced back to the parent's childhood obesity and their parent's nutritional status. Observing the biological characters of the obese parents it can be predicted that obesity at early childhood period may be associated with adulthood obesity (Whitaker *et al.,* 1997 and Magarey *et al.,* 2003).

The incidence of hypertension among mothers of both the groups was 3% and that of fathers was 7% in each group. While 3% each of mothers and fathers of non-obese children developed diabetes mellitus, 10% of the fathers of obese children developed diabetes mellitus. Three percent each of mothers of obese preschool children were found to be suffering from juvénile diabètes mellites and hypothyroidism.

The incidence of hypertension and diabetes mellitus was more among fathers compared to mothers of preschool children. This could be attributed to the increase in the incidence of obesity among fathers after marriage compared to mothers. Mothers who were obese continued to be obese even after marriage and it was not a sudden onset or recent weight gain. Quite often, women were of low height which makes them obese even for a moderate increase in weight compared to men who are relatively tall. The health risk increased with the increase in the BMI. The obese individual is more likely to develop diabetes, heart diseases, hypertension, arthritis, gall bladder stones, cancers, fertility/ pregnancy complications, respiratory ailments and decreased life expectancy (Wen-Harn Pan *et al*., 2004).

The prenatal, natal and post natal conditions of the mother and the birth order and birth weight of the child and the feeding practices during infancy will have a great influence on the child's nutritional status at the preschool age. The details of these conditions are presented as percentages applicable to non-obese and obese children in table 4.4. and 4.5.

The mean age at different pregnancies of the mothers was reported to be 24 or 25 years for the first pregnancy, 27 years for the second pregnancy, 28 or 29 years for the third pregnancy. Seventy three percent and eighty percent of mothers of non-obese and obese children had a second issue respectively while 17% and 27% of mothers of non-obese and obese children respectively had a third child also.

The average weight of mothers just before pregnancy of the child under study ranged between 53 $\pm$ 8 to 59 $\pm$ 7 kg for non-obese and obese group respectively with a significant difference ($p<0.01$) indicating that mothers of obese children in general entered pregnancy with a greater body weight compared to non-obese group. Only 30% of the mothers in each group exercised physically. The weight of mothers after six months of delivery of the child under study ranged between 61 $\pm$ 10 to 68 $\pm$ 7 kg for non-obese and obese group respectively with a significant variation between both ($p<0.01$). Mothers of both the groups retained on an average 10 kg extra weight after delivery.

Fifty seven percent non-obese children and thirty seven percent of obese children were born under normal delivery, while 43% of non-obese and 63% of obese children were born under cesarean delivery. The incidence of obesity among preschoolers was high among those born under cesarean delivery which was by 1.7 times more than children born under normal delivery. Children born through cesarean delivery were 1.4 times more likely to be overweight than children born through vaginal delivery (Rebecca 2008).

The percent of first born children under non-obese groups was 63% and 44% of the obese preschool as shown in table 4.5. More percent of second born children, 40% were found to be obese against 30% of the non-obese children. A similar trend was also seen with 13% of the third born obese children against 7% non-obese children. One child happened to be a fourth born was also obese indicating that as the birth order increases the tendency to become obese may also increase among the preschool age group.

Table 4.4. History of pre-natal, natal and post natal details of the mothers and non-obese and obese preschool children

S.no	Details	Non-Obese children (n=30)	Obese children (n=30)
	Mean age at different pregnancies of the mothers (years)		
1	First pregnancy	24 (100%)	25 (100%)
	Second pregnancy	27 (73%)	27 (83%)
	Third pregnancy	28 (17%)	29 (27%)
	Fourth pregnancy	-	29 (3%)
2	**History of pre-natal and post natal conditions of mothers for the selected subjects**		
(a)	Weight of mother just before pregnancy, kg (Mean $\pm$ SD)	53 $\pm$ 8	59 $\pm$ 7 z value = 2.95**
(b)	Physical exercise during pregnancy (% mothers exercised)	30%	30%
(c)	Weight of mothers after 6 months of delivery, kg (Mean $\pm$ SD)	61 $\pm$ 10	68 $\pm$ 7 z value = 3.28**
(d)	Kind of delivery		
	Normal	57%	37%
	Cesarean section	43%	63%

Significance Level --z-value - **-$p<0.01$ *-$p<0.05$ ^{NS} Non-significant

In any birth order girls were found to be more obese than boys and more of first born children were obese compared to second and third born children. Koziel and Kolodziej (2001) investigations show that the first-born girls were 1.5 times at higher risk of obesity in comparison to later- born girls. Differences in the proportion of overweight girls among birth order groups showed a high significance within three sibling families. Sabrina Krum *et al*., 2009 concluded that the oldest or youngest child in a family of four or more is more likely to become obese.

Fifty percent of the non-obese children and seventy percent of obese children had a birth weight of 3.0 – 4.0 kg, while 47% of the non-obese and 13% of obese had a birth weight of 2.5 – 3.0 kg as shown in table 4.5. Seventeen percent of the obese preschool children had a low birth weight i.e. below 2.5 kg.

It is very well known that a child who is born with a greater birth weight will continue to grow with a similar growth pattern and may become obese at preschool age. In contrary, a child who is born with a low birth weight may also have a greater tendency to become obese as per Barker's hypothesis. Forty seven percent of children with normal birth weight of 2.5 -3.0 kg remained non-obese indicating that ideal birth weight good for prevention of early onset of obesity.

Table 4.5. Birth order, birth weight and feeding practices during infancy of the non-obese and obese preschool children

S.no	Details	Non-Obese children (n=30)			Obese children (n=30)		
1	**Birth order of the child**		**M**	**F**		**M**	**F**
	First born	63%	27%	36%	44%	20%	24%
	Second born	30%	17%	13%	40%	13%	27%
	Third born	7%	7%	-	13%	-	13%
	Fourth born	-	-	-	3%	3%	3%
2	**Child's birth weight**						
	Less than 2.5 kg's	-			17%		
	2.5 -3.0 kg's	47%			13%		
	3.0-4.0 kg's	50%			70%		
	Above 4 kg's	3%			-		
	Average weight	3.17 kg			3.00 kg		
3	**Feeding practices during infancy**						
	Colostrum fed from the first day	73%			73%		
4	**Duration of breast feeding**						
	Less than 3 month	3%			3%		
	Less than 6 month	3%			23%		
	Up to 1 yr	53%			40%		
	Up to 2 yr	40%			33%		
5	**Initiation and feeding to supplementary foods**						
	4 month onwards	24%			24%		
	6 month onwards	63%			73%		
	8 month onwards	3%			-		
	1 yr onwards	10%			3%		
6	**Supplementary foods used**						
	Ceralax, Farex etc	53%			67%		
	Rice & dhal	63%			40%		
	Home prepared gruels	10%			20%		
7	**Childs care takers from birth to 3 years**						
	Mostly mothers	80%			97%		
	Partly / fully grandmothers	29%			18%		
	Partly / fully housemaids	33%			13%		

Several studies suggested that higher birth weight was more inducing obesity in later years of life (John.J.Reilly *et al*., 2005 and Robert K Persons and William Nichols, 2008). Based on Barkers hypothesis, Hendrina and Jane 2006 reviewed the risk of developing obesity and associated diseases in later life with low birth weight. Impaired beta-cell function during oral glucose tolerance test has been demonstrated by obese children (aged 11.6 $\pm$ 2.3 years) with low birth weight (Brufani *et al.*, 2009).

The feeding practices of non-obese and obese preschool children from birth to infancy were elicited from the mothers as shown in table 4.4. In both non-obese and obese group, 73% of children were fed colostrum immediately after birth and continued for the next 2-3 days. Fifty three percent of non-obese and forty percent of obese children were breast fed up to the age of first year and 40% of the non-obese and 33% of the obese further continued breast feeding up to two years. As many as 23% of obese preschool were fed mother's milk for less than six months period, breast fed children easily satisfy their hunger with mother's milk intake. In contrary infants on formula foods have poor responses to hunger and satiety. From the data it is evident that non-obese children had been breast fed for a long time compare to obese children.

Introduction of supplementary feeds during the first year of life was reported to be from fourth month among 24% each of non-obese and obese children, whereas majority of these children, 63% of non-obese and 73% of obese children were appropriately supplemented with additional food from six month onwards. Children who were introduced to supplementary foods later to 8 month and 12 month were mostly non-obese (13%). Besides the time of weaning and supplementation, the foods, the type of formula foods supplemented will make a greater difference in inducing obesity among infants which might continue further during preschool age. Sixty seven percent of obese preschool children and fifty three percent of non-obese preschool were given commercial supplementary foods like Ceralec , Farex etc while 20-40% of the obese and 10-63% of non-obese were fed on home prepared gruels or rice and dhal combination respectively. The higher percentage of commercial supplementary food intake among the obese from six month (73%) or fourth month (24%) could have laid foundation for obesity at this age and continued to preschool age. Habituated home based supplementary foods using rice and dhal among 63% of non-obese children were found to have maintained normal weight.

Most of the children, 80% of non-obese and 97% of obese children were mostly reared by the mother and 29% of non-obese and 18% of obese children were taken care by grandmothers and the rest of 33% of non-obese and 13% of obese children were by housemaids in their formative years of infancy up to 3 years. In general children brought up by mothers had a greater tendency to become obese than brought up by grandmothers and housemaids.

4.3 NUTRITIONAL ASSESSMENT OF NON-OBESE AND OBESE PRESCHOOL CHILDREN AND THEIR PARENTS

Nutritional assessment is an important means of judging the child's and parents nutritional status. Among the four techniques of nutritional assessment, anthropometry and diet survey have been selected for this study. M de Onis (2004) highlighted the importance and use of nutritional anthropometry to identify early childhood obesity.

Anthropometric measurements are of two types, growth and body composition, and have been widely used for the assessment of the nutritional status of both children and adults. Nutritional anthropometry has been defined as measurements of the variations of the physical dimensions and the gross composition of the human body at different age levels and degrees of nutrition.

A dietary assessment is a comprehensive evaluation of a person's food intake, an estimation of food and nutrients taken over a particular time point. Some of the most common dietary assessment methods are food records, dietary recalls, food frequency questionnaires and diet histories. In the present study, 24 hr dietary recall and food frequency methods have been used.

4.3.1. Anthropometric Assessment of Nutritional Status of Preschool Children and their Parents

Nutritional status of preschool children was assessed by taking height, weight, mid upper arm circumference and triceps skin fold measurements of the preschoolers at the school campuses and height and weight measurements of mothers and fathers were taken at their respective houses. Anthropometric measurements of children were compared with the age specific reference norms as per IAP standards (Khadhilkar *et al.*, 2007).

4.3.1.1. Anthropometric Assessment of Nutritional Status of Non-obese and Obese Preschool Children: Mean age and the mean height, weight, BMI, mid upper arm circumference and triceps skin fold measurements of the preschoolers are given in table 4.6. The age of non-obese and obese preschool children was 4.3 $\pm$ 0.6 and 4.5 $\pm$ 0.4 years respectively without any significant difference. Age of the child is one of the factors associated with obesity. Next to infancy, preschool age is one of the most

congenial ages for development of obesity (Van Rossen L *et al*., 2010, Q He *et al*., 2000 and Harsha *et al*., 2008).

From the table 4.6 it is evident that the mean height of non-obese and obese preschool children was 1.02 $\pm$ 0.05 and 1.07 $\pm$ 0.05 meters respectively without any significant difference between both the groups indicating that the height of preschool children in this study has not influenced BMI.

The heights of boys and girls in both non-obese and obese group were compared to the height for age reference growth curves of IAP (Khadhilkar et al., 2007). The average height of non-obese and obese preschool boys was 1.04 $\pm$ 0.04 meters and 1.08 $\pm$ 0.05 meters respectively and non-obese and obese preschool girls were 1.01 $\pm$ 0.05 meters and 1.06 $\pm$ 0.05 meters respectively. The height for age of boys of non-obese and obese was above 50^{th} percentile for 7 and 9 children respectively and was below 50^{th} percentile for 8 non-obese and 2 obese boys. The height for age of girls of non-obese and obese was above 50^{th} percentile for 7 and 15 respectively and was below 50^{th} percentile for 8 non-obese and 4 obese girls. Though the mean height did not differ between non-obese and obese, the individual height for age details show that both boys and girls of obese category (80%) were taller (>50^{th} percentile_ compared to non-obese preschoolers (47%). Twenty percent of obese and fifty three percent of non-obese and obese boys and girls together were < 50^{th} percentile (appendix D and E). Since majority of the obese children were found to be tall, it could be inferred that height during preschool age is not as much associated with obesity as it is with adults. Stanojevic *et al.*, 2007 finding highlights the lack of association between stunting and obesity among preschool children.

The mean weight of non-obese and obese preschool children was 16.4 $\pm$ 4.2 kg and 22.9 $\pm$ 4.5 respectively with a highly significant difference ($p<0.01$). The mean weight of non-obese and obese preschool boys was 16.19 $\pm$ 1.25 and 24.07 $\pm$ 5.13 kg respectively and that of girls was 15.36 $\pm$ 1.46 and 22.17 $\pm$ 4.20 kg respectively. The weight of boys and girls in both the groups were compared to the weight for age reference growth curves (appendix D and E) of IAP. The weight for age of boys of non-obese and obese was above 50^{th} percentile for 7 and 11 children respectively and 9 and 18 girls respectively, coming to a total of 97% of obese above 50^{th} percentile and 53% of non-obese above 50^{th} percentile, nearly 7 boys and 6 girls of non-obese group were below 50^{th} percentile of weight. Higher percentages of obese children falling above 50th percentile indicate an association between weight for age and obesity.

. BMI is the most commonly used measure for monitoring the prevalence of overweight and obesity at population level. It is also the most commonly used way of estimating whether children are overweight or obese.BMI for age reference standards by IAP (Khadhilkar *et al*., 2007) were used to categorize children as obese and non-obese. The BMI of the preschool children was derived by using Quetlet's formula

$$BMI = \frac{\text{Weight (kg)}}{\text{Height}^2 \text{ (m)}}$$

The average BMI of non-obese and obese preschool children was 14.9 $\pm$ 0.5 and 17.7 $\pm$ 2.7 respectively with highly significant difference ($p<0.01$) between the two groups. Children may acquire different height based on heredity and nutritional practices but weight is a factor mostly inferred by food practices and physical activities of the child. At the preschool age, just height and weight monitoring as was popular, may not be sufficient to judge the nutritional status; but BMI plotting on the growth curves will serve in timely identification of tendency of children towards being overweight or obese and the likely interventions in time.

The arm circumference, is an absolute measurement, varies little between the ages of one and four years. It correlates well with weight and weight for height. Middle-upper arm circumference for each age is highly discrete and it represents the protein status of preschoolers. All the non-obese and obese children were in a safe zone of mid upper arm circumference, indicating that non-obese and obese had equal musculature and no muscle wasting. The average mid upper arm circumference of non-obese and obese preschool was 16 $\pm$ 0.70 and 20 $\pm$ 2.7 cms with a high significant difference ($p<0.01$). The mid upper arm circumference of boys and girls of non-obese and obese groups compared to the reference percentile by age (Frisancho 1982) from NHANES I (1971- 1974). Five of the obese boys were under 95^{th} percentile, three were under 90^{th} percentile and the remaining two were under 75^{th} percentile indicating that most of the obese boys had high mid upper arm circumference and fell much above the 50^{th} percentile. Contrary to the obese, non-obese fell much below the 50^{th} percentile with two under 5^{th} percentile, three under 10^{th} percentile and seven under 25^{th} percentile and three under 50^{th} percentile and none in the 75^{th}, 90^{th} and 95^{th} percentile. With reference to the mid upper arm circumference of obese girls, the incidence was comparable with of obese boys with 6, 7, 3 obese girls under 95^{th}, 90^{th} and 75^{th} percentiles respectively and only 1 and 2 children under 25^{th} and 10^{th} percentiles. All non-obese girls had fallen with 1, 2, 8, 4 girls under 5^{th}, 10^{th} 25^{th} and 50^{th} percentile respectively. On the whole the

obese boys and girls matched with 75th, 90th and 95th percentile compared to non-obese boys and girls who scattered between 5th and 25th percentile.

S C S Yeung and S S C Hui (2010) reported that skinfold measurement is a reasonable estimate of percent body fat and body density in Chinese children aged 9 to 19 years old. The average triceps skin fold measurements of non-obese and obese preschool was 14.7 $\pm$ 1.2 mm and 19 $\pm$ 2.6 mm respectively with a significant difference ($p<0.01$) between the two groups. The measurements of the non-obese and obese preschoolers were compared to the reference percentile by age (Frisancho 1982) from NHANES I (1971- 1974). Majority of the non-obese (18) and (10) obese boys fell under 95th percentile and 5 non-obese girls and 14 obese girls also fell under 95th percentile, five of non-obese girls and one each of obese girls and non-obese boys were under 90th percentile and five non-obese girls under 25th percentile. The comparison of triceps skin fold measurements with NHANES I percentiles indicate that irrespective of wide variation in body weight and BMI the individual distribution of triceps skin fold measurements of the preschool children showed similar trends.

Determinants of BMI from anthropometric measurements of non-obese and obese preschool children is given in table 4.7 and the results indicate that mid upper arm circumference of the obese children influenced their BMI ($p<0.05$).

Table 4.7. Determinants of BMI from anthropometric measurements of non-obese and obese preschool children

Groups –Y (BMI)	B1`(MUAC)	B2 (TSK)	R^2	R	F value
Non-Obese children	0.08^{NS}	-0.01^{NS}	0.00	0.00	0.05^{NS}
Obese children	1.23*	0.26^{NS}	0.48	0.692	12.44*

Significance Level --t-value - **-p<0.01 *-p<0.05 ^{NS} Non-significant, F-value ^{F}-p<0.05

4.3.1.2. Anthropometric Assessment of Nutritional Status of Parents of Non-obese and Obese Preschool Children: The mean age and mean height, weight and BMI of parents of the preschoolers are given in table 4.6. and fig. 4.1. The age of the mothers of non-obese and obese preschool children was 30.2 $\pm$ 3.38 and 32.6 $\pm$ 4.35 years respectively with a significant difference ($p<0.05$) and the age of the fathers of non-

obese and obese preschool children was 36.1 ± 2.90 and 36.8 ± 3.98 years respectively without any significant difference between the two groups.

The average height of the mothers of non-obese and obese preschool children was 1.59 ± 4.8 and 1.59 ± 4.7 meters respectively with no significant difference between the groups and the average height of the fathers of non-obese and obese preschool children was 1.7 ± 6.4 and 1.7 ± 6.3 meters respectively without any significant difference. The average weight of the mothers of non-obese and obese preschool children was 61.9 ± 8.3 and 66.8 ± 8.3 kg respectively with a significant difference ($p<0.05$) and the average weight of the fathers of non-obese and obese preschool children was 69.4 ± 9.6 and 79 ± 10.6 kg respectively with a significant difference ($p< 0.01$).

Body mass index of parents has been calculated to classify them normal, overweight or obese. As a person's body fat increases, both their BMI and their future risk of obesity-related illness also rise, BMI is an easy, cheap and non-invasive means of assessing excess body fat among adults.

The average BMI of the mothers of non-obese and obese preschool children was 24.9 ± 3.7 and 26.8 ± 3.2 respectively with a significant difference at $p<0.05$ and the average BMI of the fathers of non-obese and obese preschool children was 23.9 ± 2.83 and 26.4 ± 3.1 respectively with a significant difference at $p< 0.01$. The percent of mothers and fathers of preschool children under normal, overweight, obese groups are given in table 4.8.

Table 4.8. Distribution of parents of non-obese and obese preschool children under BMI classification

	Normal (18.0 – 22.0 kg/ $m^{2)}$ (n=30)	**Overweight (23.0 – 24.9 kg/ $m^{2)}$ (n=30)**	**Obese (>25.0 kg/ $m^{2)}$ (n=30)**
Mothers of NOb PSC	43% (13)	20% (20)	37% (37)
Mothers of Ob PSC	10% (3)	37% (11)	53% (16)
Fathers of NOb PSC	43% (13)	23% (7)	33% (10)
Fathers of Ob PSC	3% (1)	27% (8)	70% (21)

Figures in parenthesis indicate the no. of subjects
Values are percent figures

Among the mothers, 43% of the mothers of non-obese children maintained a normal BMI, while 20% and 37% of them were overweight and obese. Comparatively

105 of the mothers of obese preschool children were normal and 37% overweight and remaining 53% of them were obese. It was clear that high percent of mothers of non-obese children were also obese or overweight compared to mothers of obese children, not ruling out the fact that ¾ of the mothers of non-obese children were also obese. More than 50% i.e. 23% and 33% of fathers of non-obese children were overweight and obese respectively and only 43% maintained a normal BMI, whereas majority of the fathers of obese children were overweight 27% and obese 70% leaving 3% in the normal range.

The results indicate that there is no significant difference between the height of mothers and fathers of non-obese and obese group but there was a marked difference between the weights and BMI of mothers and fathers of non-obese and obese group as shown in table 4.6.

The determinants of non-obese and obese children anthropometric measurements from their parent's anthropometric measurements are presented in table 4.9. The BMI of non-obese children is shown to be influenced by their mothers ($p<0.05$) but not fathers. There was no significant relation observed between the BMI of obese children either with their mothers or fathers. The height of non-obese children is determined by the height of their fathers ($p<0.01$) but not by their mothers.

Table 4.9. Determinants of anthropometric measurements of non-obese and obese preschool children from their parents anthropometric measurements

S.no	Groups – Y(BMI)	B1`(Mothers)	B2(Fathers)	R^2	R	F value
1	BMI of obese children	-0.0177 ^{NS}	-0.1405 ^{NS}	2.9318	0.1712	0.4077 ^{NS}
2	BMI of non-obese children	0.0536*	-0.010 ^{NS}	0.1620	0.4025	2.6107 ^{NS}
3	Height of obese children	-0.0475 ^{NS}	0.1542 ^{NS}	3.6249	0.1903	0.5077 ^{NS}
4	Height of non-obese children	0.2622 ^{NS}	0.3933**	0.3136	0.5600	6.1701^{F}
5	Weight of obese children	0.0242 ^{NS}	-0.0062 ^{NS}	2.2184	4.7100	3.0015 ^{NS}
6	Weight of non-obese children	-0.0474 ^{NS}	0.0334 ^{NS}	7.9251	8.9023	0.1078 ^{NS}

Significance Level --t-value - **-$p<0.01$ *-$p<0.05$ ^{NS} Non-significant, F-value ^{F}-$p<0.05$

There anthropometric measurements of parents of obese children did not influence their children anthropometric measurements indicating that obesity among preschoolers could be an independent mechanism. The results indicate that mothers maintaining normal BMI have a positive influence on the child's BMI, whereas height of fathers and not mothers had more influence on non-obese child's height.

4.3.2 Dietary Assessment of Non-obese and Obese Preschool Children and their Parents

Dietary assessment is a comprehensive evaluation of an individual food intake. A three day food intake record from the child, mother and father was obtained through 24 hour diet recall method. Average food intake of three days was calculated. Based on the food intake record, nutrient intake was calculated using tables of Nutritive Value of Indian Foods (Gopalan *et al.*, 2009). Proximate nutrients carbohydrates, protein and fat intake and total calorie intake were calculated from the different of each food consumed. Percent calories obtained from each of the proximate nutrients were calculated from the total calories. Food frequency for common high caloric foods given to preschool children was specially designed and it is consolidated under practices of KAP test.

4.3.2.1. Dietary Assessment of Nutritional Status of Non-obese and Obese Preschool Children: The dietary intake of the three macronutrients providing energy to the body, the carbohydrates, proteins and fats and the total energy was estimated for non-obese and obese preschool children and is presented in table 4.10.

The mean intake of energy, carbohydrate, protein and fat of the non-obese and obese preschool children is graphically illustrated in fig 4.2 and 4.3. It was found that the mean energy intake of non-obese children was 1189 $\pm$ 193 kcals which was significantly ($p<0.01$) lower than obese preschool children energy intake which was 1857 $\pm$ 525 kcals. The average of carbohydrate intake of non-obese children and obese children was 164 $\pm$ 32 gm and 251 $\pm$ 87 gm respectively and obese children consumed significantly high amount of carbohydrates ($p<0.01$) compared to non-obese preschool children. The average protein intake of obese children was 46 $\pm$ 11.8 gm which was significantly higher ($p<0.05$) than non-obese children with 37 $\pm$ 21 gm intake. The mean fat intake of non-obese children and obese children was 43 $\pm$ 17 gm and 71.4 $\pm$ 18 gm respectively with a significant high fat intake among obese children.

The energy and proximate nutrient intake of preschool children indicate that obese children relatively had a very high intake of all these energy nutrients which have a direct link to the causation of obesity. Increased fat and carbohydrate intake above the recommended dietary allowances have been proved to be converted to excess fat storage, thereby increasing body weight, further leading to overweight or obesity.

The percent carbohydrate calories consumed by non-obese and obese preschool children was 55 $\pm$ 11 and 56 $\pm$ 6 gm respectively and no significant difference was found between the two groups. Similarly the mean percent calories from protein was 12 $\pm$ 5 and 10 $\pm$ 2 for non-obese and obese preschool children respectively, while the percent calories from fat was 33 $\pm$ 9 and 34 $\pm$ 5 respectively with no significant difference between the two groups either for protein calories or percent fat calories. Along with mean nutrient intakes, the distribution of total calories into percent carbohydrates, protein and fat calories has also been given in table 4.10. and fig 4.4.

Though there was a highly significant difference between the energy, carbohydrate and fat intake of non-obese and obese preschool children, the percent calories of the carbohydrate, protein and fat of the non-obese and obese preschool children did not show any significant difference. This relatively shows a similarity and balance in the type and percent calorie intake of non-obese and obese preschool children and was close to the recommended percent calories as 55-60% carbohydrate calories, 10-15% protein calories and 30-35% fat calories for preschool children.

The nutrient intakes of preschool were also compared with RDA for preschool children as per the revised requirements suggested by ICMR (Narsinga Rao 2010) as shown in table 4.11. In general children of both age groups had moderate to very high intakes of protein, fat and total energy except the energy intake of non-obese 4-5 year preschool children whose energy intake was less by 10% compared to recommended dietary allowances. Obese children have a much greater intake of protein, fat and energy compared to that of non-obese children. Obese children of 3-4 year consumed on an average nearly 184% more fat, 187% more protein and 96% more energy against 84% more fat, 122% more protein and 10% more energy consumed by the non-obese children. Percent difference for all these nutrients though high compared to recommended dietary allowances for 4-5 year old children, it was not as high as it was

for 3-4 years. The obese children of 4-5 years showed a high fat intake of 177% Vs 7% in non-obese, protein of 199% Vs 93% non-obese and 37% energy Vs -10% in non-obese children.

This data clearly indicates that preschool children in general were fed high amounts of fat and protein though greater intake of ghee, fried snacks and through milk and milk product, reflecting in a moderate e higher intakes of overall energy.

In the present study the determinants of dietary factors of non-obese and obese preschool children has been illustrated in Table 4.12. The results indicate that the carbohydrate intake of 3-4 year obese children majorly contributed to their total energy intake ($p<0.01$) while the carbohydrate, protein and fat intake of non-obese children did not show any impact on their total energy intake.

In the 4-5 years obese children, the energy calories majorly came from their carbohydrate and fat intake ($p< 0.001$) while only the fat intake of non-obese children contributed to their energy intake. S A Gibson (2000) associated a high fat-low carbohydrate macronutrient composition to the increased energy density which induces passive over consumption.

Lisa & Peter (2000) found no relation between dietary intakes of total energy, carbohydrate, fat or protein and percent body fat in children aged 1.5 – 4.5 years. A 4-day weighed-food record was used to determine intakes of total energy and energy from each macronutrient. Average energy intake was 4759 kJ/d for the total sample. Mean values for diet composition indicated that carbohydrate provided 57.4% of energy, fat provided 30.5%, and protein provided 12.1%. There were no significant correlations between percentage body fat and any of the intake variables. The habitual level of physical activity had an influence on body composition, in contrast with energy and macronutrient intakes, which did not affect body composition.

The anthropometric measurements of the non-obese and obese preschool children did not influence their total energy intake as shown in 4.13.

4.3.2.2. Dietary Assessment of Nutritional Status of Parents of Non-obese and Obese Preschool Children: The mean intake of energy, carbohydrate, protein and fat of parents of non-obese and obese preschool children is presented in table 4.10. It was found that the mean energy intake of mothers of non-obese and obese children was

1389 ± 310 kcals and 1742 ± 503 kcals respectively, showing that calorie intake of mothers of obese children was significantly higher ($p<0.01$) than of mothers of non-obese. The average carbohydrate intake of mothers of non-obese children was 184 ± 41.84 gm and that of mothers of obese had a significance higher ($p<0.01$) intake of 237 ± 98 gm respectively. Similar trend was observed in the mean fat intake of mothers of obese children with 65 ± 33 gm which was significantly higher ($p<0.05$) than the fat intake of 50 ± 12 grams of mothers of non-obese. The mean protein intake of mothers of non-obese and obese children was 38 ± 10 gm and 43 ± 14 gm respectively without any significant difference.

The mean energy intake of fathers of non-obese and obese children was 1491 ± 327 kcals and 1637 ± 446 kcals respectively without any significant difference between the two groups. The mean carbohydrate intake of fathers of non-obese and obese children was 242 ± 23 gm and 217 ± 60 gm respectively did not show any significance difference. The average protein intake 40 ± 9 and 43 ± 16 gm and the mean fat intake 52 ± 13 and 63 ± 33 gm of fathers of non-obese and obese children in the respective order did not show any significant difference between the two groups indicating that fathers had relatively similar eating patterns compared to mothers of preschoolers.

The nutrient intakes of parents of the preschoolers were also compared with RDA as per the revised requirements suggested by ICMR as shown in table 4.11. In general, mothers of both non-obese and obese children had 24% and 8% less energy intake, 29-27% less protein intake in the respective groups compared to the recommended dietary allowances. But mothers of both the groups had a higher fat intake with 118% more in non-obese and 277% more in obese group. Fathers of both the groups also showed a similar tendency with energy, protein and fat intake very close to that of respective group of mothers. Though majority of fathers and mothers were found to be obese, their dietary intake, especially energy and protein were found to be around 30-34% less than the recommended dietary allowances. This trend could be understood as fluctuating in dietary intakes specially when eating outside would have added to the increased consumption and the present data was only the home based dietary intake. Another factor which has to be thought of is that the obesity acquired with a history of 2-3 years origin would maintain at all levels even without eating foods as per the normal requirements. This mechanism must be continuing to keep them obese.

Determinants of the dietary factors of parents of non-obese and obese preschool children have been illustrated in table 4.12. The results indicate that the energy intake of mothers of non-obese children largely came from their carbohydrate and fat intake ($p<0.01$) while dietary factors of mothers of obese children did not show any linear correlation with their total energy intake. The carbohydrate intake ($p<0.05$) and protein intake ($p<0.01$) of fathers of obese children made a strong impact on their total energy. The carbohydrate intake ($p<0.01$) and fat intake ($p<0.05$) of fathers of non-obese children added significantly more calories to the total energy intake.

The anthropometric measurements like height and weight of parents of non-obese and obese preschool children did not influence their total energy intake as shown in 4.14.

4.4 KNOWLEDGE –ATTITUDE –PRACTICE (KAP) OF PARENTS (MOTHER'S) OF NON-OBESE AND OBESE PRESCHOOL CHILDREN ON CHILDHOOD OBESITY RELATED FACTORS

Knowledge, Attitude and Practices (K-A-P) have been identified to be influencing food habits and lifestyle of people. In the present study, the knowledge, attitude and practices of subjects on obesity associated factors were analyzed.

4.4.1. Knowledge

The information was collected from the mothers of obese and non-obese children regarding their knowledge about childhood obesity through multiple choice questions on identification of obesity (5 questions), causes (2 questions), consequences (3 questions), dietary principles (8 questions), management (6 questions) and physical activity (6 questions). Initial the questionnaire contained a set of 30 questions. The response to each question is presented in appendix F.

The range of total score for correct answers was 14 to 23 with mean of 18 for mothers of non-obese and for mothers of obese children the scores ranged from 6 to 24 with a mean score of 18, indicating that mothers of obese children to be more knowledgeable on childhood obesity compared to the control group. Inspite of better knowledge, mothers of obese children could not have put the knowledge in practice.

Response analysis of knowledge was carried out for each item. Percent correct and incorrect responses of mothers were calculated for each question under the category and average was taken and the details are listed in table 4.15.

Nearly equal percent of mothers from both the groups, 51053% had correct knowledge related to identification of obesity and 47-49% of mothers had inadequate knowledge of the obesity identification criteria. Similar trend was observed with regard to knowledge related to causes of obesity, where 62% and 63% of mothers of non-obese and obese children had correct knowledge and 37-39% of mothers were not aware of the causes of childhood obesity

Table 4.15. Distribution of mothers of non-obese and obese preschool children based on knowledge related to childhood obesity

	Non-obese children		Obese children	
Categories	**Correct responses (n=30)**	**Incorrect responses (n=30)**	**Correct responses (n=30)**	**Incorrect responses (n=30)**
Identification	51%	49%	53%	47%
Causes	62%	38%	63%	37%
Consequences	44%	56%	52%	48%
Dietary principles	67%	33%	63%	37%
Management	61%	31%	77%	23%
Physical activity	69%	31%	77%	23%

High percent of mothers of obese children, nearly 52% know the consequences of childhood obesity, but it was not reflected in the child's nutritional status compared to 44% of mothers of non-obese children with correct answers. Most of the mothers of non-obese 56% and 48% of mothers of obese children were not aware of consequences of childhood obesity. A large number of mothers 67% of non-obese and 63% of obese groups were found to be quite knowledgeable about the dietary information related to obesity as against 33% and 37% of non-obese and obese mothers who were unaware of dietary knowledge.

Sixty percent and seventy seven percent of mothers of non-obese and obese children respectively were well aware of obesity management principles. Only 31% and 23% of mothers of non-obese and obese children did not have knowledge related to

management of obesity. Sixty nine percent of mothers of non-obese and seventy seven percent of mothers of obese children know the importance of physical activity and 31% and 23% of mothers of non-obese and obese children did not know about importance of physical activity.

On the whole, 53-77% mothers of obese children were found to be more knowledgeable about childhood obesity compared to 44-69% of mothers of non-obese children, suggesting that inspite of better knowledge mothers sometimes tend to ignore to put the knowledge in practice.

4.4.2. Attitude

The second exploratory factor was to assess the mother's attitude towards obesity, their child being obese and the healthy dietary practices. The questionnaire with attitude statements is given under appendix C. The proposed questionnaire had 21 statements which were to be answered on a scale of five point continuum as strongly agree, agree, undecided, disagree, strongly disagree. The positive attitude statements were scored in the order of 5, 4,3,2,1 on the five point scale and scores were in the reverse order for the negative statements.

The statements were related to physiological aspects of obesity, desirable weight, concern for prevalence of obesity, likelihood of an obese child developing obesity in his/her adulthood, energy giving nutrients, food which provides empty calories and instant energy, high energy value of oil, dietary fiber, restricting children for high caloric foods, importance of physical activity, TV viewing, consumption of snacks while viewing and the best approach for counseling for the treatment of childhood obesity.

The responses in the five point scale were scored and classified under attitudes scores, 1-49 as low, 50-77 as medium, 78-105 as high as sown in table 4.16. The responses were tabulated and analyzed. The results showed that 40% of the mothers of obese children had 'high' attitude scores and the remaining 60% had 'medium' score of 50-77% whereas 100% of the mothers of the non obese children showed 'medium' score.

Table 4.16. Distribution of mothers of non-obese and obese preschool children in various attitude categories related to childhood obesity

Scale	Mothers of NOb PSC (n=30)	Mothers of Ob PSC (n=30)
01-49	-	-
50-77	30%	60%
78-105	-	40%

The results indicate that mothers of obese children had better attitude towards obesity related factor on par with knowledge. It clearly shows that mothers might have good knowledge about foods, nutrition; health related aspects but theirs might not be a complete knowledge and they might not know the quantities of food requirements appropriate, selection of foods, their specific nutritional value and also the cut off levels for various food practices.

4.4.3. Practice

Introduction of healthy eating habits and regular physical in the early years of life of children are likely to become their lifestyle patterns throughout their life and thus may help to decrease risk of the onset of obesity in them. In the present study the dietary habits of non-obese and obese children and their family dietary practices were studied through a questionnaire (appendix C).

4.4.3.1. Frequency consumption of energy rich foods: The frequency of consumption of various foods offered to children was collected and presented in table 4.17. The consumption of milk and milk products emphasizes that 87% of both non-obese and obese children consumed milk with horlicks on a daily basis and 10% and 3% of non-obese and obese children respectively consumed on alternate days. Greater percentage of non-obese children consumed curds daily -33%, alternate days -20% and weekly -10% compared to a less percent of obese children consuming curds daily – 7%, alternate days – 20%, weekly -30% and the rest were not in the habit of taking curds. Intake of ice cream either weekly , fortnightly or occasionally among obese was 33% , 27% and 17% in the respective frequency order compared to less percent of non-obese consuming ice cream either weekly -10% , fortnightly -17% or occasionally 13%. No or least number of preschool children was offered ice cream either daily or on alternate days in either of the groups. Intake of milk based pudding was a fortnightly -10% or occasional- 20% practice among no-obese children while more obese children were consumed weekly -20%, fortnightly 13% and not all children were in the practice of taking pudding.

The consumption of fresh whole fruits was high either daily -80% or alternate days-20% among non-obese children and nearly 60% and 40% of obese children consumed fresh fruits daily and on alternate days respectively. Thirteen percent each of non-obese were in the habit of drinking fruit juices either daily or weekly while 20% of them took fruit juices on alternate days. Thirty three percent of obese children were in the habit of drinking fruit juices on alternate days and thirteen percent each were in the habit of taking fruit juices daily or weekly. Intake of fruit milk shakes was a practice only in obese children with 30% of them consuming on alternate days and 7% weekly. Dry fruit consumption among non-obese and obese children was 20% and 23% respectively on weekly basis, 20% and 17% respectively had once in fortnight and 17% and 23% occasionally in the respective groups. Ten percent of obese children had either daily or alternate day consumption of dry fruits.

The consumption of calorie rich sweets, chips, cakes, confectionary and fruit biscuits were high among the obese children compared to non-obese. While 10% and 13% of non-obese were taking sweets weekly ,occasionally and fortnightly basis, greater percent of obese children 20-30% either daily or on alternate days or weekly or fortnightly.

It was generally found during the interviews that any food that is demanded by the obese was served and the demand was more frequent compared to non-obese. This may indicate that hunger cues are high among obese children and they preferred high caloric variety snacks in response to their hunger cues.

4.4.3.2 . Dietary practices of non-obese and obese children: The meal pattern and eating habits are given in table.4.18. The results show that 60% and 54% of non-obese and obese children consumed milk and milk products twice a day. Barba *et al*., 2003 showed an inverse association between frequency of milk consumption and body mass in children. Regular intake of breakfast items was reported to be among 73% of non-obese and 37% of obese and 77% and 83% of non-obese and obese children consumed three meals times a day. Sixty seven percent and thirty three percent of non-obese and obese children respectively consumed snacks once a day, 10% and 20% of non-obese children consumed twice and 20% and 44% of non-obese and obese children consumed snacks several times a day.

High meal frequency was inversely associated with childhood obesity. The prevalence of obesity decreased by number of daily meals: 3 or less, 5% (95%CI 4 to 6%), 4 meals, 3% (95%CI 2 to 4%) and 5 or more meals 2% (95%CI 2 to 4%) at $p < 0.05$ (Toschke *et al*., 2009). Hollie & Rena (2007) explains that increase in the amount of food intake produced an 81% increase in energy consumed from the snack foods [large amount (2782 _ 1174 kcal) vs small amount (5028 _ 2596 kcal)] in college aged man and women.

None of the non-obese children and 23% of the obese children had the habit of binging snacks while watching TV. Twenty three percent and thirty three percent of non-obese and obese respectively get influenced by the TV commercials. Donna *et al.*, 2004 explains children who consumed more calories from fat while watching television had higher BMI's.

Soft drinks, beverages etc on a daily basis always consumed by 10% and 17% of non-obese and obese children, none of the non-obese children and 13% of the obese children binge on high caloric foods in between meals, none of the non-obese children and 10% of the obese children binge on high caloric foods throughout the day, 23% and 30% of non-obese and obese children sometimes behaved as voracious eater as shown in Table 4.18.

4.4.3.3 Child's feeding practices: The child's feeding practices like who feeds the child, child's patience in eating, the incidence of forced food feeding are given in table 4.19.

Fifty seven percent of obese children fed themselves and fifty percent of them were fed by their mothers while fifty three percent of non- obese children fed themselves and fifty seven percent of them were fed by their mothers. When asked the mothers whether variety in food is essential or not 50% of them agreed while the remaining 50% partially agreed under obese group and among mothers of non-obese children, 60% of them agreed while the remaining 40% partially agreed.

When asked mothers whether children were interested in food or not, 83% of obese children and 93% of non-obese children answered that their children were interested in food. The duration of patience while having food among non-obese and obese preschool was reported to be 15 minutes for 33% and 47% of respective groups, 30

minutes for 63% and 43% of children respectively and very few had patience of 45minutes.

Sixty percent of either non-obese or obese children had to be occasionally fed but 23% of each group had to be forced fed once or twice a week. Ten percent of non-obese had to be force fed every day.

Table 4.19. Child's feeding practices

Dietary practice	Non-Obese children (n=30)	Obese children (n=30)
Child is fed by		
Child himself/herself	53%	57%
Mother	57%	50%
Grandmother	7%	7%
Housemaid	-	3%
Variety in food		
Partially agree	40%	50%
Agree	60%	50%
Interested in food	93%	83%
Duration of patience while eating		
15 minutes	33%	47%
30 minutes	63%	43%
45 minutes	3%	10%
Incidence of forced eating		
Always	10%	3%
Once or twice a week	23%	23%
Never	7%	13%
Occasionally	60%	60%

4.4.3.4. Foods hidden from the child's reach: In the present study the foods which were restricted or hidden from the reach of children are listed in the table 4.20. Restricting access can sensitize children to external eating cues while increasing their desire to obtain and consume the restricted food. Several studies indicated that restricting access to foods may increase children's preferences (Birch *et al.*, 1980, Lepper *et al.*, 1982 and Jennifer & Leann, 1999) and intake of restricted foods (Fisher & Birch 2000) while diminishing self-control in eating (Mischel & Ebbesen, 1970).

Table 4.20. Foods hidden from the child's reach

Groups	Foods hidden
Non-obese children	Chips, chocolates, fruit biscuits, cream biscuits, oily foods
Obese children	Jellies, fruit biscuits, chocolates, cola drinks, bakery items, chips, dry fruits

Mothers of non-obese children often hide chips, chocolates, fruit biscuits, cream biscuits, oily foods from their children while mothers of obese children hide Jellies, fruit biscuits, chocolates, cola drinks, bakery items, chips, dry fruits thinking that excess intake of these food is not healthy for children.

4.4.3.5. Foods served in the school lunch boxes: The various food items which were served in the child's lunch box are given in table 4.21. Though mothers have reported a variety of food items giving into the lunch box of children, quite often the food served like chips, cookies, biscuits, bread with jam/butter in limited quantities. Obese children showed better appetite and intake and some of them were served quantity cereal based dishes.

Table 4.21. Foods commonly served in lunch boxes of non-obese and obese preschool children

Groups	Food served in lunch box
Non-obese children	Veg upma, bread and butter, bread jam, murkoos, chappati, puri, roti, boiled egg, bread jam, curd rice, tomato rice,veg pulao, egg friedrice, fruit custard, fruits, noodles, egg sandwich, chips, idly, dosa, upma, dry fruits, biscuits, cake slices
Obese children	Veg pulao, curd rice, tomato rice, bread with jam, biscuits, chips, cakes, egg friedrice, idly, dosa, puri, aloo paratha, uttampam with vegetables, roti and omelette, fruit milk shakes, fruit custard , wheat dalya, khicdhi, chapatti and jam, dosa and jam, cheese sandwich, dry fruits, cookies, puri with potato, chicken nuggets , noodles, lemon rice, muffins, nutella sandwich

4.4.3.6. Physical activity pattern of non-obese and obese children: Physical activity of children as judged by their frequency of active willingness to play, participation in games, motivation factors, length of time spent on indoor games is given in table 4.22.

While 30% of obese children were not allowed to play outdoors, 20% were allowed sometimes, 37% were often allowed to play outdoors. Forty seven percent and forty percent of non-obese were either allowed sometimes or often allowed to play outdoor respectively. 13 percent each of each non-obese and obese children were allowed to play outdoors. Nearly 40-50 percent of non-obese and obese children was either often or always took part in school games and other physical performances. Children voluntarily and readily took part in school activities in the frequencies of sometimes-33 percent, often-20 percent, and always 40 percent among non-obese group and sometimes-23 percent, often-40 percent and always-40 percent among obese group.

For nearly 30 percent of non-obese children sometimes and 45 percent of them rarely required and 20 percent never required motivation to be physically active and participate in physical activities. Similarly 47 percent of obese children sometimes and 37 percent of them rarely required motivation of physical activity. A marked difference is found in the readiness of non-obese children for physical activity compared to the obese children.

Nearly 37 percent to 40 percent of obese and non-obese children were off to sleep immediately after coming back from school but 17-23 percent of obese children rarely or never slept while 10-20 percent of non-obese children always or often slept after coming back from school. Nearly 100 percent of the non-obese and 90 percent of the obese children were never or rarely allowed to play video games or computer games for more than two hours. 27 percent of non-obese and 13 percent of obese children sometimes sat in front of television for more than two hours but 30 percent non-obese and 17 percent obese often or always sat for more than two hours watching television. All children had adequate sleep except 7 percent of obese children who slept less than eight hours.

On the whole, obese children spent longer hours sitting and watching television and more mothers of obese children (30-40%) didn't allow them to play outdoors indirectly indicating that, mothers influence physical inactivity of obese children.

Ekelund *et al*, (2005) showed a relation between less physical activity and body fat mass. John.J.Reilly *et al.*, 2005, observed odds ratio for obesity increased linearly as the number of hours of television viewing increased. For children reported to watch television for 4-8 hours per week at age 3 the adjusted odds ratio for obesity at age 7 was 1.37 (1.02 to 1.83). For those reported to watch more than eight hours per week the adjusted odds ratio was 1.55 (1.13 to 2.12). Sleep duration in children aged 30 months was independently associated with prevalence of obesity at age 7.Children in the lowest two quarters of sleep duration (< 10.5 hours and 10.5-10.9 hours) were more likely to be obese at age 7 than children in the highest quarter, > 12 hours.

Physical activity is very important during the early life stages for proper growth and development. A combination of sound nutritional practice and adequate physical activity for all young population represents a cost effective option to reduce the risk or prevent obesity and many other disease. Regular physical activity and appropriate eating

patterns should be employed from birth. Very young children are dependent on responsible adults to provide as guidance, to act as role models.

Therefore parent's attitude, encouraging family based activity and providing opportunities in the environment to facilitate activity should be targeted when considering intervention in children.

4.4.3.7. General dietary habits of the families of non-obese and obese children: The family's general dietary habits as frequency of going out for eating, quantity and type of oil consumed at home, type of milk etc are given as percentages of families in table 4.23.

The family is usually together at dinner times, during the day everyone has their own engagements. Eating out habits among non-obese and obese children families for dinner were 80% and 83%, for snacks was 7% and 27%, for lunch 17% and 13% in the respective groups. Fifty three percent of non-obese and 60% of obese children families go out once a week for dining out.

The oil which was used by the majority 77% and 50% of the obese and non-obese children families was sunflower oil, which was followed by groundnut oil, with 13% frequency both in obese and non-obese group families use it. After sunflower oil, it is the safflower oil which is mostly used by the obese group. No marked difference was observed in the quantity of oil used by the non-obese and obese children's families which almost averaged to 4.70 liters.

The type of milk which mostly used was whole milk among 70% of the obese group families and 63% of non-obese group families while the rest used toned milk.

The frequency of going out for dining out was more among obese children families and more of them were in the habit of snacking outside along with dinner. In general the oil consumption of both the groups was found to be high nearly seven of non-obese group were joint families with greater number of family members.

Dinning out habits, oil consumption and whole milk consumption was relatively high among obese group indicating high intakes of energy rich diets. The frequent items ordered by the two groups are given in appendix G and the obese group had greater number of fat foods selected compared to non-obese group.

Table 4.23. General Dietary practices of families of non-obese and obese preschool Children

Dietary Practices	Family of NOb PSC (n=30)	Family of Ob PSC (n=30)
Eating out habits		
Breakfast	-	10%
Lunch	17%	13%
Snacks	7%	27%
Dinner	80%	83%
Frequency of eating out		
Daily	-	-
Once a week	53%	60%
Twice a week	13%	13%
3-4 times a week	-	10%
Never	20%	7%
Occasionally	13%	10%
Cooking oil used		
Safflower oil	7%	27%
Sunflower oil	77%	50%
Rice bran	3%	7%
Coconut oil	-	-
Mustard oil	-	3%
Groundnut oil	13%	13%
Quantity of oil used	4.68 liters	4.7 liters
Milk used		
Whole milk	63%	70%
Toned milk	37%	33%

The foods commonly prepared at home by the two groups for different meal times and special occasions are listed in appendix H. Though many foods were common traditional ones, obese group families had great variety and constituted mostly energy and fat dense cereal, milk and meat based dishes.

Table 4.6. Anthropometric measures of non-obese and obese preschool children and their parents

		Preschool children			Mothers of			Fathers of		
S.no	**Measurements**	**NOb n=30**	**Ob n=30**	**Z value**	**NOb PSC n=30**	**Ob PSC n=30**	**Z value**	**NOb PSC n=30**	**Ob PSC n=30**	**Z value**
1	Age (years)	4.3 ± 0.6	4.5 ± 0.4	0.15 ^{NS}	30.2 ± 3.38	32.6 ± 4.35	2.45*	36.1 ± 2.90	36.8 ± 3.98	0.78^{NS}
2	Height (m)	1.02 ± 0.05	1.07 ± 0.05	0.05 ^{NS}	1.59 ± 4.8	1.59 ± 4.7	0.001 ^{NS}	1.7 ± 6.4	1.7 ± 6.3	0.006 ^{NS}
3	Weight (kg)	16.4 ± 4.2	22.9 ± 4.5	3.31**	61.9 ± 8.3	66.8 ± 8.3	2.27*	69.4 ± 9.6	79 ± 10.6	3.85**
4	BMI	14.9 ± 0.5	17.7 ± 2.7	9.89**	24.9 ± 3.7	26.8 ± 3.2	2.19*	23.9 ± 2.83	26.4 ± 3.1	3.19**
5	MUAC (cms)	16 ± 0.70	20 ± 2.7	8**						
6	TSK (mm)	14.7 ± 1.2	19 ± 2.6	8.6**						

Significance Level --z-value - **-p<0.01 *-p<0.05 ^{NS} Non-significant
MUAC: Mid upperarm circumference
TSK : Tricep skinfold

Table 4.10 Dietary intakes of non-obese and obese preschool children and their parents

		Preschool children			Mothers of			Fathers of		
S.no	**Nutrient**	**NOb n=30**	**Ob n=30**	**z value**	**NOb PSC n=30**	**Ob PSC n=30**	**z value**	**NOb PSC n=30**	**Ob PSC n=30**	**z value**
1	Energy	1189 ± 209	1857 ± 525	6.48**	1388 ± 310	1742 ± 503	3.2**	1491 ±328	1637 ± 446	1.44 NS
2	Carbohydrate	164 ± 32	251 ± 86	5.19**	184 ± 42	237 ± 98	2.77**	242 ± 23	217± 60	-2.1 NS
3	Protein	37 ± 21	46 ± 12	2.09*	38 ± 10	43 ± 15	1.59 NS	41 ± 9	44 ± 16	0.92 NS
4	Fat	43 ± 17	71 ± 18	6.22**	50 ± 12	65 ± 33	2.35*	52 ± 13	63 ± 33	1.56 NS
5	Percent carbohydrate calories (%)	55 ± 11	56 ± 6	0.43 NS	57 ± 9	58 ± 14	0.1 NS	58 ± 8	56 ± 15	-0.66 NS
6	Percent protein calories (%)	12 ± 5	10 ± 2	-0.53 NS	11 ± 3	9 ± 3	-3 NS	11 ± 3	11 ± 2	Nil
7	Percent fat calories (%)	33 ± 9	34 ± 5	0.53 NS	32 ± 8	33 ± 12	0.12 NS	31 ± 7	33 ± 3	1.44 NS

Significance Level --z-value - **-p<0.01 *-p<0.05 NS Non-significant
NOb PSC: Non-obese preschool children
Ob PSC: Obese preschool children

Table 4.12. Multiple linear regressions between dietary factors of non-obese and obese preschool children and their parents

S.no	Groups Y(Energy)	B1 (CHO)	B2 (Protein)	B3 (Fat)	R2	R	F value
1	3-4 yr obese children	10.5**	-16.9 ^{NS}	13.4 ^{NS}	0.9	0.9	113.31^{F}
	3-4 yr non obese children	1.6 ^{NS}	3.6 ^{NS}	4.8 ^{NS}	0.1	0.4	0.17 ^{NS}
2	4-5 yr obese children	1.8**	1.0 ^{NS}	15.2**	0.8	0.9	31.70^{F}
	4-5 yr non obese children	0.4 ^{NS}	2.9 ^{NS}	10.4**	0.6	0.8	1.55 ^{NS}
3	Mother's of obese children	1.4 ^{NS}	10.6 ^{NS}	5.1 ^{NS}	0.6	0.7	115.75^{F}
4	Mother's of non obese children	5.7**	-0.8 ^{NS}	8.2**	0.8	0.9	115.75^{F}
5	Father of obese children	2.0*	22.1**	-2.1 ^{NS}	0.7	0.8	24.60^{F}
6	Father's of non obese children	4.2**	3.1 ^{NS}	9.9*	0.6	0.8	16.56^{F}

Significance Level --t-value - **-p<0.01 *-p<0.05 ^{NS} Non-significant, F-value ^{F}-p<0.05

Table 4.11. Percent deviation of nutrient intake of non-obese and obese children from the Recommended Dietary Allowance*

Subjects	Energy (kcals)			Protein (grams)			Fat (grams)		
	Intake	RDA	% difference	Intake	RDA	% difference	Intake	RDA	% difference
NOb PSC 3-4 yr	1144 ± 193	1036	10 ± 19	35 ± 6	15.7	122 ± 42	44 ± 13	25	84 ± 56
Ob PSC 3-4yr	2032 ± 810		96 ± 78	46 ± 10		187 ± 54	71 ± 23		184 ± 94
NOb PSC 4-5 yr	1219 ± 219	1350	-10 ± 16	39 ± 27	20.3	93 ± 132	43 ± 11	25	70 ± 44
Ob PSC 4-5yr	1813 ± 442		37 ± 33	46 ± 13		119 ± 61	72 ± 17		177 ± 69
Mothers of NOb PSC	1388 ± 310	1899	-24 ± 19	38 ± 10	55	-29 ± 19	50 ± 12	20	118 ± 50
Mothers of Ob PSC	1742 ± 503		-8 ± 27	43 ± 14	55	-27 ± 26	65 ± 33		227 ± 163
Fathers of NOb PSC	1491 ± 328	2318	-37 ± 14	41 ± 9	60	-32 ± 15	52 ± 13	25	108 ± 81
Fathers of Ob PSC	1637 ± 446		-32 ± 23	44 ± 16		-28 ± 27	63 ± 33		207 ± 149

* Reference RDA values as given by Narsinga Rao Bulletin of the Nutrition Foundation of India January 2010 Vol 31

Table 4.13. Determinants of energy intake of non-obese and obese preschool children from their anthropometric measurement

S.no	Groups Y (energy)	B1 (BMI)	B2 (Height)	B3 (Weight)	B4 (MUAC)	B5 (TSK)	R2	R1	F value
1	Energy of obese children	-265.5 ^{NS}	-8159.6 ^{NS}	227.7 ^{NS}	116.6 ^{NS}	-39.9 ^{NS}	0.1	0.4	1.00 ^{NS}
2	Energy of non-obese children	-157.2 ^{NS}	75.1 ^{NS}	0.4 ^{NS}	16.1 ^{NS}	51.9 ^{NS}	0.1	0.4	1.19 ^{NS}

Significance Level --t-value - **-p<0.01 *-p<0.05 ^{NS} Non-significant, F-value ^{F}-p<0.05

Table 4.14. Determinants of energy intake of parent's non-obese and obese preschool children from their anthropometric measurement

S.no	Groups Y (energy)	B1(BMI)	B2(Height)	B3 (Weight)	R2	R	F value
1	Mother's of Obese children	86.4 ^{NS}	215.2 ^{NS}	-18.8 ^{NS}	9.5	0.3	0.91 ^{NS}
2	Mother's of Non-obese children	-32.1 ^{NS}	-880.8 ^{NS}	2.9 ^{NS}	7.8	0.2	0.73 ^{NS}
3	Fathers of Obese children	-90.8 ^{NS}	-787.2 ^{NS}	28.8 ^{NS}	0.1	0.3	1.36 ^{NS}
4	Fathers of Non-obese children	24.4 ^{NS}	-119.5 ^{NS}	-4.7 ^{NS}	1.8	0.1	0.16 ^{NS}

Significance Level --t-value - **-p<0.01 *-p<0.05 ^{NS} Non-significant, F-value ^{F}-p<0.05

Table 4.17 Frequency of consumption of high caloric food by the non-obese and obese preschool children

Food items	Non-obese children (n=30)					Obese children (n=30)				
	Daily	**Alternate**	**Weekly**	**Fortnightly**	**Occasionally**	**Daily**	**Alternate**	**Weekly**	**Fortnightly**	**Occasionally**
Milk with horlicks	87%	10%	-	-	-	87%	3%	-	-	-
Curd	33%	20%	10%	3%	-	7%	20%	13%	-	-
Ice-cream	-	-	10%	17%	13%	3%	-	33%	27%	17%
Pudding	-	-	3%	10%	20%	-	3%	20%	13%	7%
Fresh fruits	80%	20%	-	-	-	60%	40%	-	-	-
Fruit juices	13%	20%	13%	3%	-	13%	33%	13%	-	3%
Fruit milk shakes	-	-	-	-	-	-	30%	7%	-	-
Dry fruits	-	-	20%	20%	17%	7%	3%	23%	17%	23%
Fruit biscuits	-	-	10%	13%	17%	-	3%	23%	13%	27%
Sweets	-	-	10%	13.3%	10%	3%	-	30%	20%	10%
Cakes	-	-	-	3%	-	7%	17%	20%	7%	17%
Chips	10%	23%	33%	17%	17%	80%	13%	7%	-	-
Chocolate/ confectionery	23%	20%	7%	23%	27%	60%	23%	7%	7%	3%

Table 4.18. Distribution of non-obese and obese preschool children under different dietary habits

No .of feeds per day	**Non-Obese children (%) (n=30)**					**Obese children (%) (n=30)**				
	Once	**Twice**	**Thrice**	**Four times**	**Not fixed**	**Once**	**Twice**	**Thrice**	**Four times**	**Not fixed**
Milk and milk products	-	60%	7%	3%	30%	3%	54%	13%	3%	27%
Breakfast items	73%	27%	-	-	-	57%	43%	-	-	-
Meals	-	23%	77%	-	-	-	17%	83%	-	-
Snacks	67%	10%	3%	-	20%	33%	23%	-	-	44%
Activities	**Never**	**Rarely**	**Sometimes**	**Often**	**Always**	**Never**	**Rarely**	**Sometimes**	**Often**	**Always**
Eating snacks while watching TV	13%	30%	47%	10%	-	3%	14%	37%	23%	23%
Getting influenced by TV food commercials	17%	23%	23%	14%	23%	14%	10%	20%	23%	33%
Consuming soft drinks, beverages etc on a daily basis	53%	14%	23%	-	10%	20%	40%	20%	3%	17%
Binging on high caloric foods in between meals	40%	30%	23%	7%	-	30%	17%	30%	10%	13%
Binging on high caloric foods throughout the day	63%	20%	17%	-	-	27%	46%	17%	-	10%
Is a voracious eater	40%	37%	23%	-	-	30%	37%	30%	3%	-

Table 4.22. Distribution of non-obese and obese preschool children under physical activity pattern

Activities	Non-obese children (n=30)					Obese children (n=30)				
	Never	**Rarely**	**Sometimes**	**Often**	**Always**	**Never**	**Rarely**	**Sometimes**	**Often**	**Always**
Physical activeness of child	-	-	-	3%	97%	-	-	3%	10%	87%
The child is allowed to play outdoors	-	-	47%	40%	13%	10%	20%	20%	37%	13%
Child take part in school games and physical performances	-	-	13%	40%	47%	-	-	7%	50%	43%
The child readily take part in activities on his/her own	-	7%	33%	20%	40%	-	3%	23%	40%	34%
The child need constant motivation to be physically active	20%	44%	30%	3%	3%	10%	37%	47%	3%	3%
The child immediately go off to sleep after coming back from school	7%	23%	40%	20%	10%	23%	17%	37%	13%	10%
The child use computer for more than 2 hrs	67%	33%	-	-	-	53%	30%	10%	7%	-
The child play video games for more than 2 hrs	70%	27%	3%	-		83%	7%	10%	-	-
The child sit in front of TV for more than 2 hrs	43%	23%	27%	-	7%	13%	27%	13%	30%	17%
Sleeping hours - $\geq$8 hrs	100%					93%				
<8hrs	-					7%				

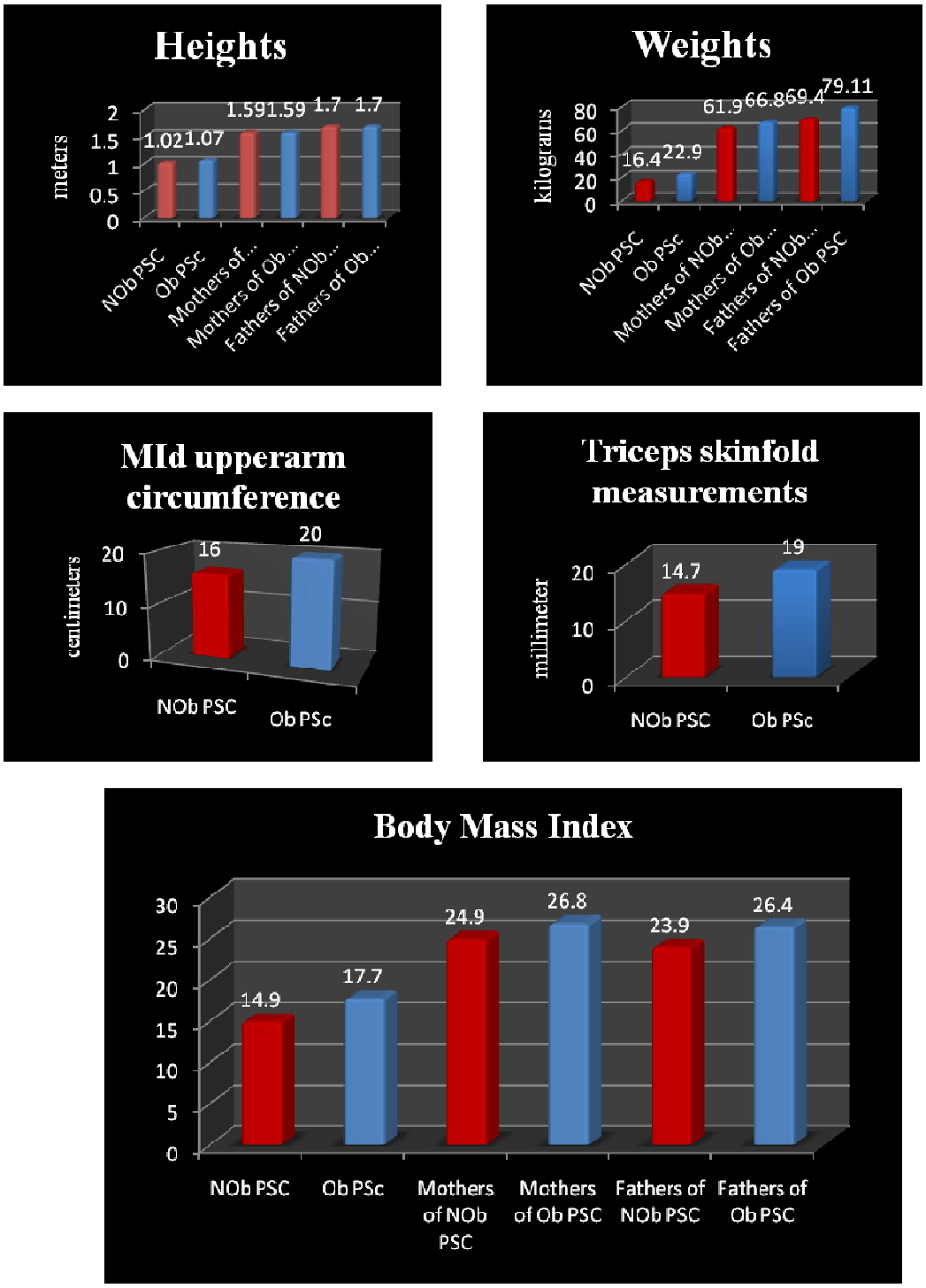
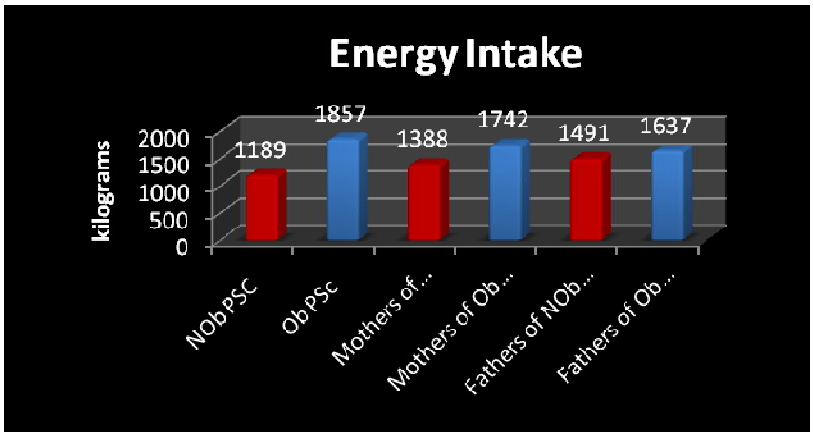


Figure: 4.1. Anthropometric measurements of non-obese and obese preschool children and their parents.



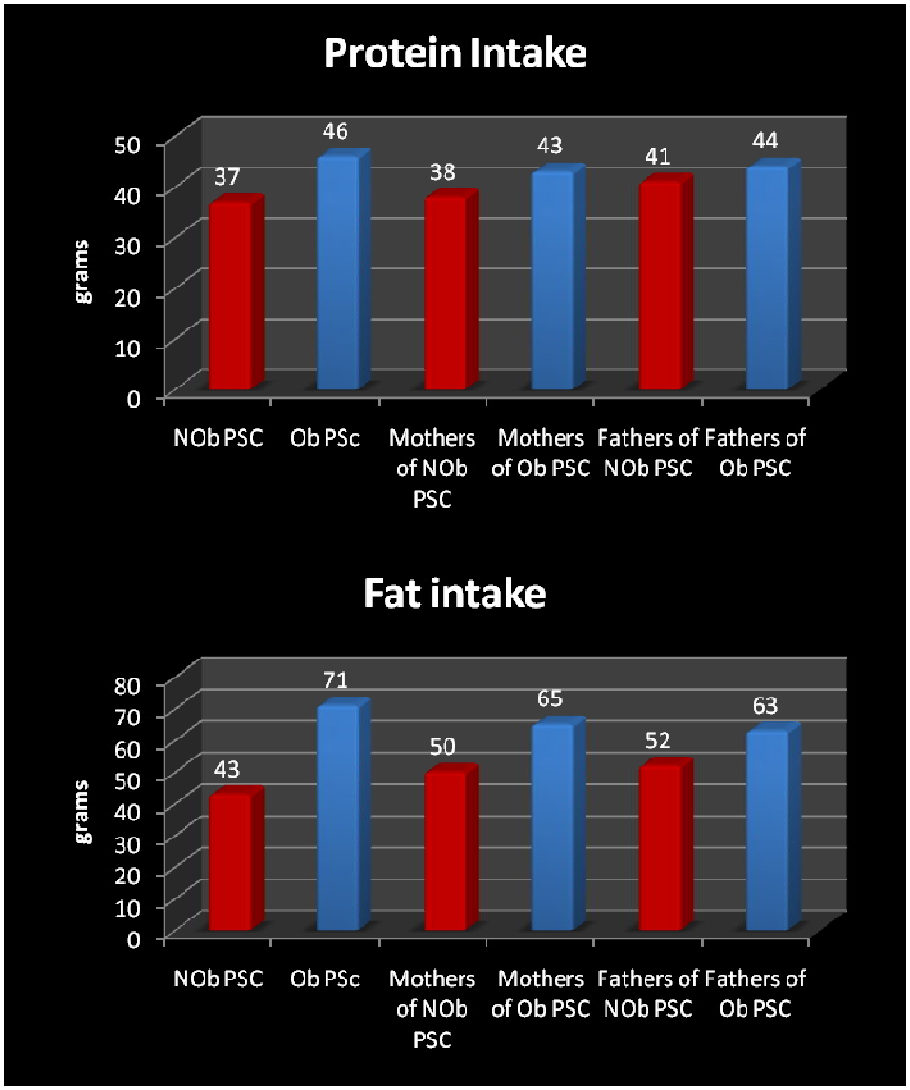


Figure 4.2: Energy , protein and fat intake of Non-obese (NOb)and obese (Ob) preschool children (PSC) and their parents

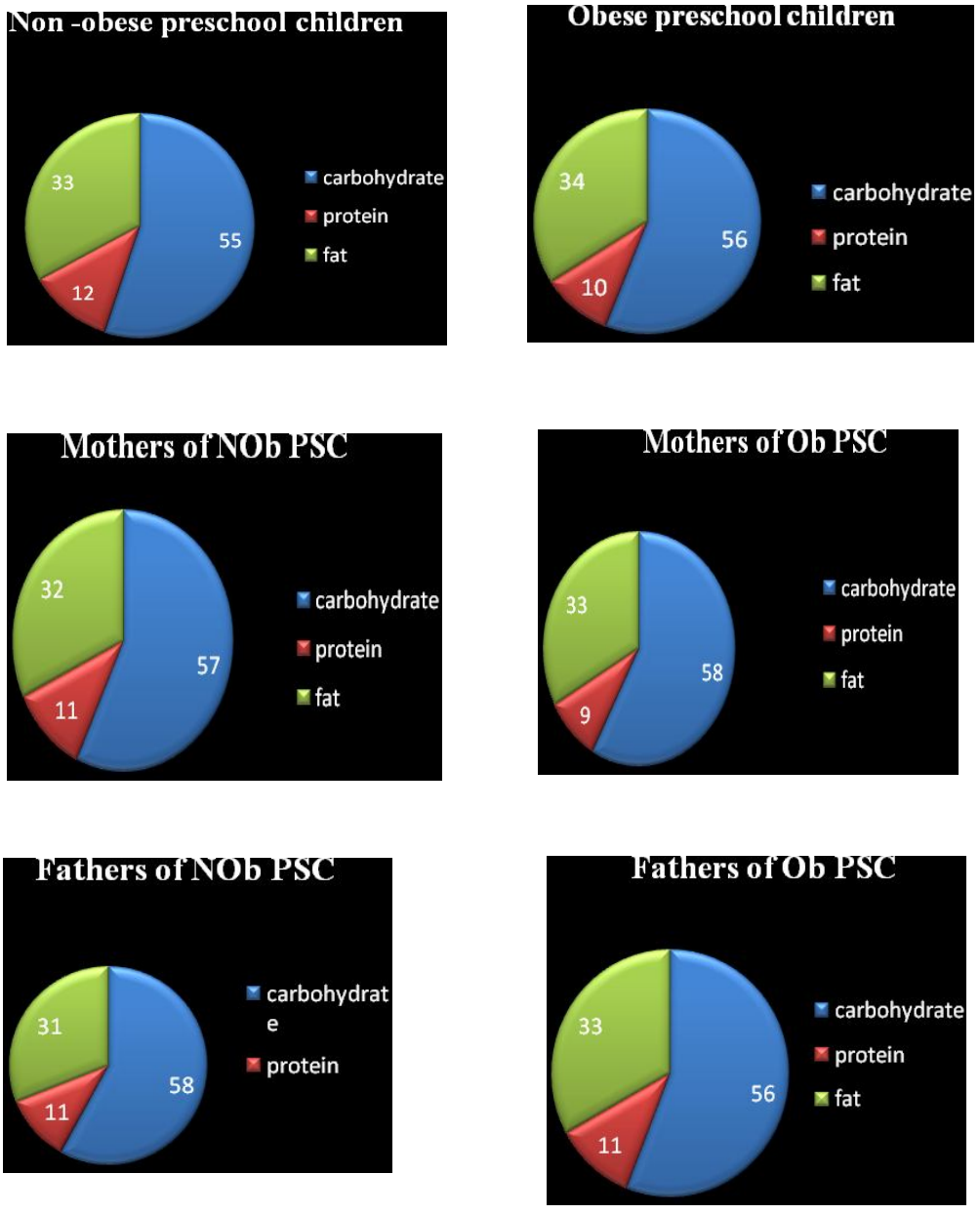
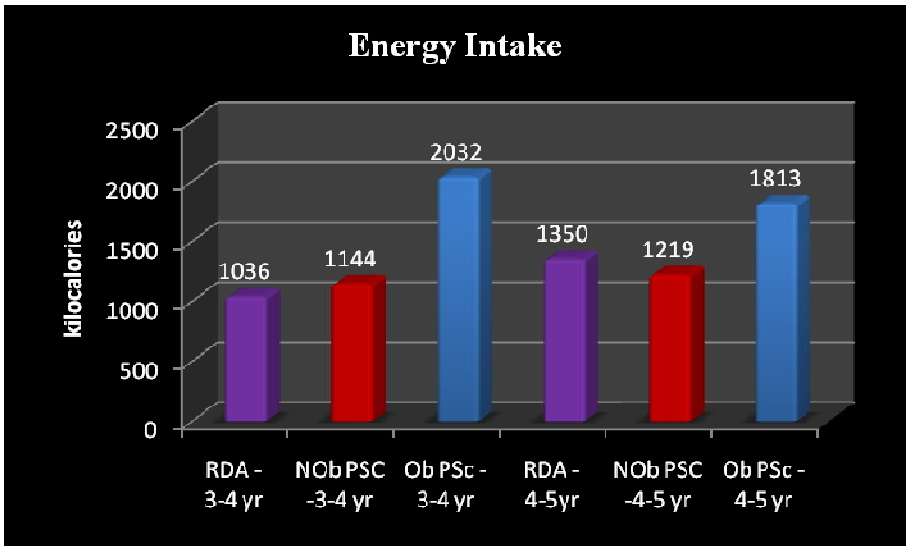
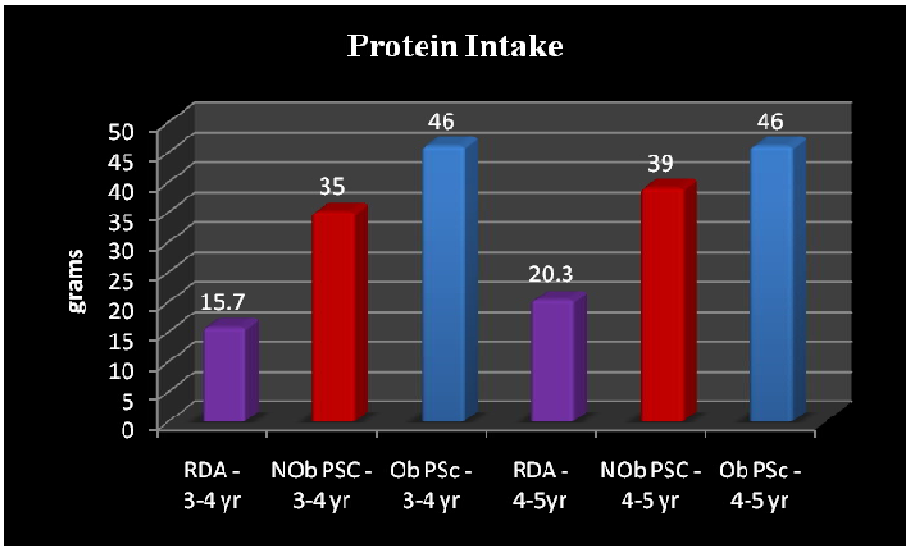


Figure 4.4.: Average percent of calories of macronutrients from the total energy of Non-obese (NOb)and Obese (Ob) preschool children (PSC) and their parents


Energy Intake
kilocalories
2500
2000
1500
1000
500
0
1036
1144
2032
1350
1219
1813
RDA - 3-4 yr
NOb PSC -3-4 yr
Ob PSc - 3-4 yr
RDA - 4-5yr
NOb PSC -4-5 yr
Ob PSc - 4-5 yr


Protein Intake
grams
50
45
40
35
30
25
20
15
10
5
0
15.7
35
46
20.3
39
46
RDA - 3-4 yr
NOb PSC - 3-4 yr
Ob PSc - 3-4 yr
RDA - 4-5yr
NOb PSC - 4-5 yr
Ob PSc - 4-5 yr

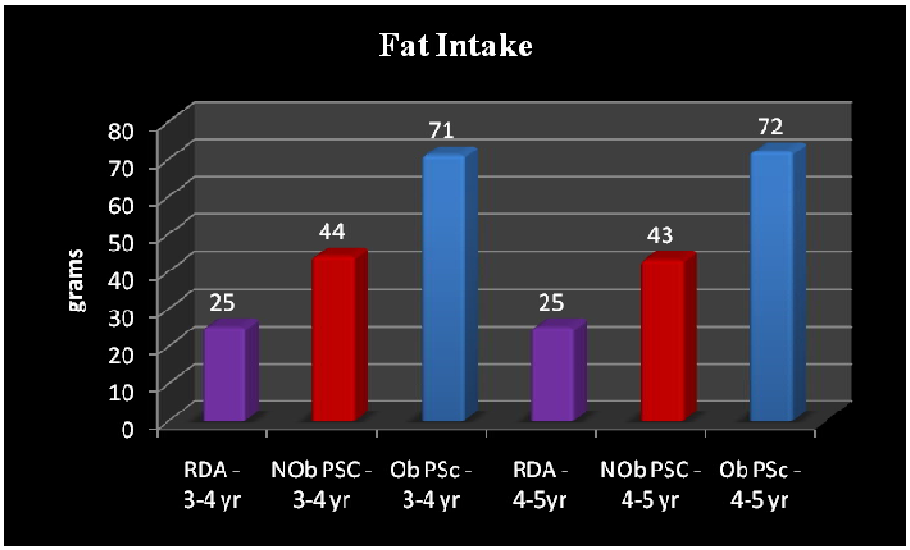


Figure 4.3.: Energy , protein,fat intake of Non-obese (NOb) and Obese (Ob) preschool children (PSC) in comparision with Recommended Dietary Allowance

CHAPTER V

SUMMARY AND CONCLUSION

The present study, "Nutritional Assessment of Obese Preschool Children and the Associated Factors" was aimed to study the factors responsible for the onset of obesity at such an early age of life.

From the selected five private schools, boys and girls of preschool age between 3-5 years were screened for BMI and 30 children with BMI >95th percentile were selected as obese children and 30 children with BMI between 25th - 50th percentile were selected as non-obese controls. Both the groups were selected after taking consent from their parents through the school administration and willingness of parent's to be a part of the study was also ascertained.

Nutritional status of preschoolers and their parents was assessed through anthropometry and dietary assessment. Knowledge, attitude and practices (K-A-P) of parents on obesity related aspects were studied through a structured questionnaire. The causes of obesity among preschool children could be traced back to demographic, socio-economic and cultural factors of the family, and the same was obtained through a questionnaire.

The mean age of fathers and mothers of obese children was 36.8 $\pm$ 3.98 and 32.6 $\pm$ 4.35 years respectively and that of their mean age at marriage was 28 and 23 years respectively. Obese preschoolers consisted of 36% boys and 64% girls, with 20% of them between 3-4 years and 80% between 4-5 years age. More number of girls compared to boys and more number of 4-5 year old children compared to 3-4 year preschoolers were found to be obese, indicating that girls have a greater tendency to become obese during preschool age and preschool age between 4-5 year seem to be promoting obesity.

The incidence of obesity among preschool children was high among children of mothers with graduate level of education (60%, n=30) and fathers with PG/professional education (53%, n=30). Inverse association between mother's educational level and childhood obesity after the age of three years has been reported by Van Rossen *et al*., (2010). Sixty seven percent of mothers of obese children were not occupied in any active employment but were homemakers. Children of fathers in

business (30%), practicing physicians (20%) and employed in private service (23%) were obese, owing to the affluence associated with their profession. Sixty seven percent of the obese children's families were found to be under a moderately high income between Rs 20,000 – 50,000/- per month. The smaller the family the larger was the prevalence of obesity, as more resources in terms of income, food and recreation were available. Obese preschool children (100%) belonged to nuclear family with a family size of < 4 members (67%, n=30) and medium size 5-6 members (33%).

Observing the biological characters of the parents of obese preschool children, fifty three to fifty seven percent of mothers were either overweight or obese during childhood, before marriage and after marriage. Thirty three percent of fathers of obese children reported that they were either overweight or obese during childhood and 27% and 40% of them were overweight or obese before and after marriage respectively. With the increase in the BMI, the risk of metabolic disorders and other diseases increases. Three percent of mothers and seven percent of fathers of obese children were hypertensive, while 10% and 3% of fathers and mothers developed diabetes mellitus respectively.

The prenatal, natal and post natal conditions of the mother and the birth order and birth weight of the child and the feeding practices during infancy were obtained through the questionnaire. The average weight of mothers of obese children just before pregnancy of the child under study was 59 $\pm$ 7 kg which was significantly higher to 53 $\pm$ 8 kg weight of mothers of non-obese children ($p<0.01$) indicating that mothers of obese children in general entered pregnancy with a greater body weight compared to non-obese children's mothers. Only 30% of the mothers of obese children exercised physically. The weight of mothers after six months of delivery of the child under study ranged between 68 + 7 to 61 $\pm$ 10 kg for obese and non-obese group respectively with a significant variation between the groups ($p<0.01$).

Thirty seven percent of obese children were born under normal delivery, while 63% of them were born under cesarean delivery. The incidence of obesity among preschoolers was high among those born under cesarean delivery which was 1.7 times more than children born under normal delivery. Forty four percent and forty percent of obese children were first and second born respectively while 13% and 3% were third and fourth born respectively, indicating that the lower the birth order, the greater the tendency to become obese. In any order girls were found to be more obese than boys and more of first born children were obese compared to second and third born children.

Seventy percent of the obese children had a birth weight of 3.0- 4.0 kg while 13% of them had a birth weight of 2.5- 3.0 kg and 17% had a low birth weight <2.5 kg. Several studies suggest that higher birth weight was more inducing obesity in later years of life (John J R *et al.*, 2005 and Robert *et al.*, 2008).

The feeding practices of the children from birth to infancy were elicited from their mothers. Seventy three percent of the obese children were fed colostrum immediately after birth and continued for the next 2-3 days. Forty percent and thirty three percent of obese children were breast fed up to the age of first and second year respectively. Early introduction of supplementary feeds among obese children has been observed. The higher percentage of commercial supplementary food intake among the obese children from six month (73%) or fourth month (24%) could have laid foundation for obesity at this age and continued to preschool age. Habitual home based supplementary food using rice and dhal among 63% of non-obese children were found to have maintained normal weight. Majority of obese children (97%) were reared by the mothers, 18% and 13% of them were taken care by grandmothers and housemaids in their formative years of infancy up to 3 years indicating children brought up by mothers had a great tendency to become obese than children brought up by grandmothers and housemaids.

Nutritional status of preschool children was assessed by taking their height, weight, mid upper arm circumference and triceps skinfold measurement of the preschoolers at the school campuses and height and weight measurements of parents were taken at their respective houses. Anthropometric measurements of children were compared with the age specific reference norms as per IAP standards (Khadhilkar *et al.*, 2007). Not much of significant difference was observed between the heights of non- obese children (1.02 + 5.2 meters) and obese children (1.07 + 0.05 meters). The heights of non-obese children were compared to the height for age reference growth curves of IAP. Both boys and girls of obese category (80%) were taller (>50^{th} percentile) indicating the lack of association between stunting and obesity among preschoolers.

The mean weight of non-obese and obese children was 16.4 $\pm$ 4.2 and 22.9 $\pm$ 4.5 kg respectively with a highly significant difference ($p<0.01$). The weight of boys and girls in both groups were compared to the weight for age reference growth curves of IAP. Higher percentages of obese children falling above 50th percentile indicate an association between weight for age and obesity. There was a marked significant difference between the BMI of non-obese and obese children (14.9 $\pm$ 0.5 and 17.7 $\pm$ 2.7, $p<0.01$).

The average mid upper arm circumference of non-obese and obese preschool was 16 $\pm$ 0.70 and 20 $\pm$ 2.7 cms with a high significant difference ($p<0.01$). The obese boys and girls matched with 75^{th}, 90^{th} and 95^{th} percentile compared to non-obese boys and girls who scattered between 5^{th} and 25^{th} percentile when compared to NHANES I. The average triceps skin fold measurements of non-obese and obese preschool was 14.7 $\pm$ 1.2 mm and 19 $\pm$ 2.6 mm respectively with a significant difference ($p<0.01$) between the two groups. The comparison of triceps skin fold measurements with NHANES I percentiles indicate that irrespective of wide variation in body weight and BMI the individual distribution of triceps skin fold measurements of the preschool children showed similar trends. Mid upper arm circumference was found to be a determinant of BMI of obese children ($p<0.05$), from the linear regressions equations.

The average height of the mothers and fathers of non-obese and obese preschool children showed no significant difference, while weight of the mothers of non-obese and obese preschool children with 61.9 $\pm$ 8.3 and 66.8 $\pm$ 8.3 kg respectively differed significantly. Weight of the fathers of non-obese and obese preschool children was 69.4 $\pm$ 9.6 and 79 $\pm$ 10.6 kg respectively with a significant difference ($p< 0.01$). The average BMI of the mothers of non-obese and obese preschool children was 24.9 $\pm$ 3.7 and 26.8 $\pm$ 3.2 respectively with a significant difference at $p<0.05$ and the average BMI of the fathers of non-obese and obese preschool children was 23.9 $\pm$ 2.83 and 26.4 $\pm$ 3.1 respectively with a significant difference at $p< 0.01$. A high percent of mothers of non-obese children were also obese or overweight compared to mothers of obese children, not ruling out the fact that ¾ of the mothers of non-obese children were obese. More than 50% i.e. 23% and 33% of fathers of non-obese children were overweight and obese respectively and only 43% maintained a normal BMI, whereas majority of the fathers of obese children were overweight 27% and obese 70% leaving 3% in the normal range. The determinants of anthropometric measurements of non-obese and obese children from their parents were identified using linear regressions. Results indicated that BMI of mothers of non-obese children influenced their children's BMI ($p<0.05$) and the height of fathers of non-obese children influenced their children's heights ($p<0.01$). No impact of the anthropometric measurements of parents of obese children was found on the anthropometric measurements of obese child.

The dietary intake of the three macronutrients providing energy to the body, the carbohydrates, proteins and fats and the total energy was estimated from 24-hour dietary recall data for both the groups. The energy and proximate nutrient intake of preschool

children indicate that obese children relatively had a very high intake of all these energy nutrients which have a direct link to the causation of obesity. Increased fat (71.4 $\pm$ 18 gm) and carbohydrate (251 $\pm$ 87 gm) intake above the recommended dietary allowances have been proved to be converted to excess fat storage, thereby increasing body weight, further leading to overweight or obesity. The percent calories consumed from carbohydrates, protein and fat showed no significant difference between the groups.

The nutrient intake of preschool children was also compared with RDA for preschool children as per the revised requirements suggested by ICMR. In general both non obese and obese children had higher intakes of all nutrients compared to RDAs. Obese children of 3-4 years consumed on an average 184% more fat Vs 84% more in non-obese, 187% more protein Vs 122% more in non-obese and 96% more energy Vs 10% more in non-obese children. The obese children of 4-5 years showed a high fat intake of 177% Vs 7% high in non-obese, protein of 199% more Vs 93% more in non-obese and ? 37% more energy. Results of linear regressions showed that the carbohydrate intake of 3 -4 yr children strongly influenced their energy intake ($p<0.01$) and for the 4-5 year old obese children, carbohydrate and fat intake and only fat intake of non-obese children showed a strong impact on their energy intake ($p<0.01$). Results also indicate that anthropometric measurements of non-obese and obese children did not determine their energy intake.

The carbohydrate and fat intake of mothers of non-obese children showed a strong impact on their energy intake ($p<0.01$). The energy intake of fathers of obese children was more determined by protein ($p<0.01$) and carbohydrate ($p<0.05$) while the carbohydrate intake ($p<0.01$) and fat ($p<0.05$) determined the energy intake of fathers of non-obese children. Mothers of both the groups had a higher fat intake with 118% more in non-obese and 277% more in obese group. Fathers of both the groups also showed a similar tendency with energy, protein and fat intake very close to that of respective group of mothers. Though majority of fathers and mothers were found to be obese, their dietary intake, especially energy and protein were found to be around 30- 34% less than the recommended dietary allowances.

Knowledge, Attitude and Practices (K-A-P) have been identified to be influencing food habits and lifestyle of people. In the present study, the knowledge, attitude and practices of subjects on obesity associated factors were analyzed. The range of total scores for correct answers was 14 to 23 with a mean of 18 for mothers of non-obese and

6 to 24 with a mean score of 18 for mothers of obese children, indicating that mothers of obese children were more knowledgeable on childhood obesity compared to the control group. The second exploratory factor assessed was mother's attitude towards obesity, their child being obese and dietary practices. The results showed that 40% of the mothers of obese children had 'high' attitude scores and the remaining 60% had 'medium' scores, whereas 100% of the mothers of the non obese children showed 'medium' score. Inspite of better knowledge, mothers of obese children seems to have not put the knowledge in practice.

The consumption of calorie rich dry fruits, sweets, chips, cakes, confectionary and fruit biscuits were high among the obese children compared to non-obese. Forty four percent of obese children consumed snacks several times a day. None of the non-obese children, but 23% of the obese children had the habit of binging snacks while watching TV. Soft drinks, beverages etc on a daily basis was always consumed by 17% obese children. While none of the non-obese children binge on high calorie foods, 13% of the obese children binge on high caloric foods in between meals and 10% binge throughout the day. Eighty three per cent of obese children were found to be interested in food. The duration of patience while having food among obese preschool was reported to be 15 minutes for 47%, 30 minutes for 43% respectively and very few had patience of 45 minutes.

Obese children spent longer hours sitting and watching television and more mothers of obese children (30-40%) didn't allow them to play outdoors indirectly indicating that, mothers induced physical inactivity in obese children. A marked difference was found in the readiness of non-obese children for physical activity compared to the obese children.

Parents can influence their children's dietary practices, satiety regulations, physical activity, sedentary habits and availability and accessibility of foods. Parent's knowledge of nutrition and modeling behavior and attitudes is very influential on children's nutritional status. Parents should play as role models and try to foster healthy lifestyles using different strategies for good feeding practices and involve children in physically active recreation rather than passive TV watching and indoor plays.

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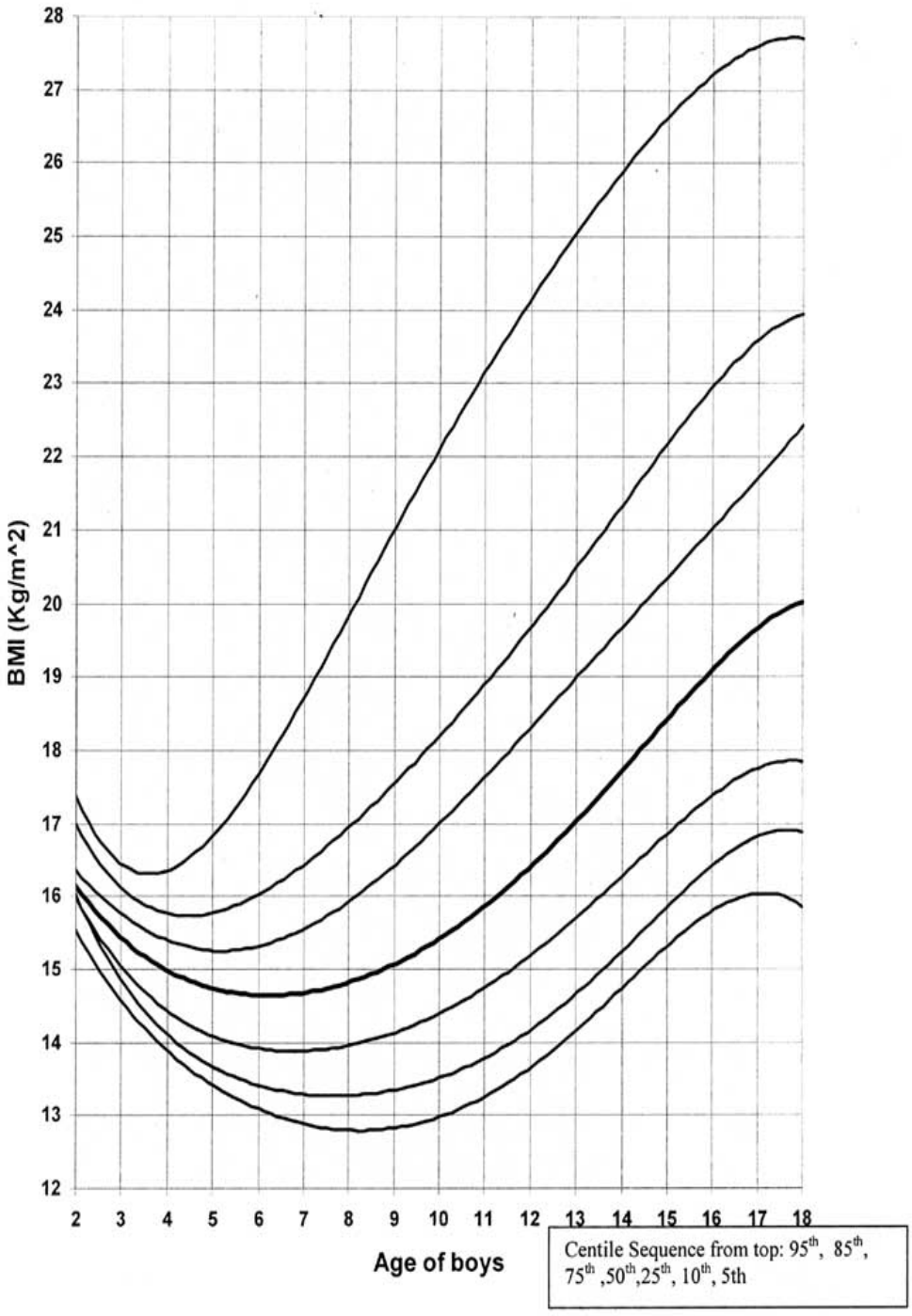
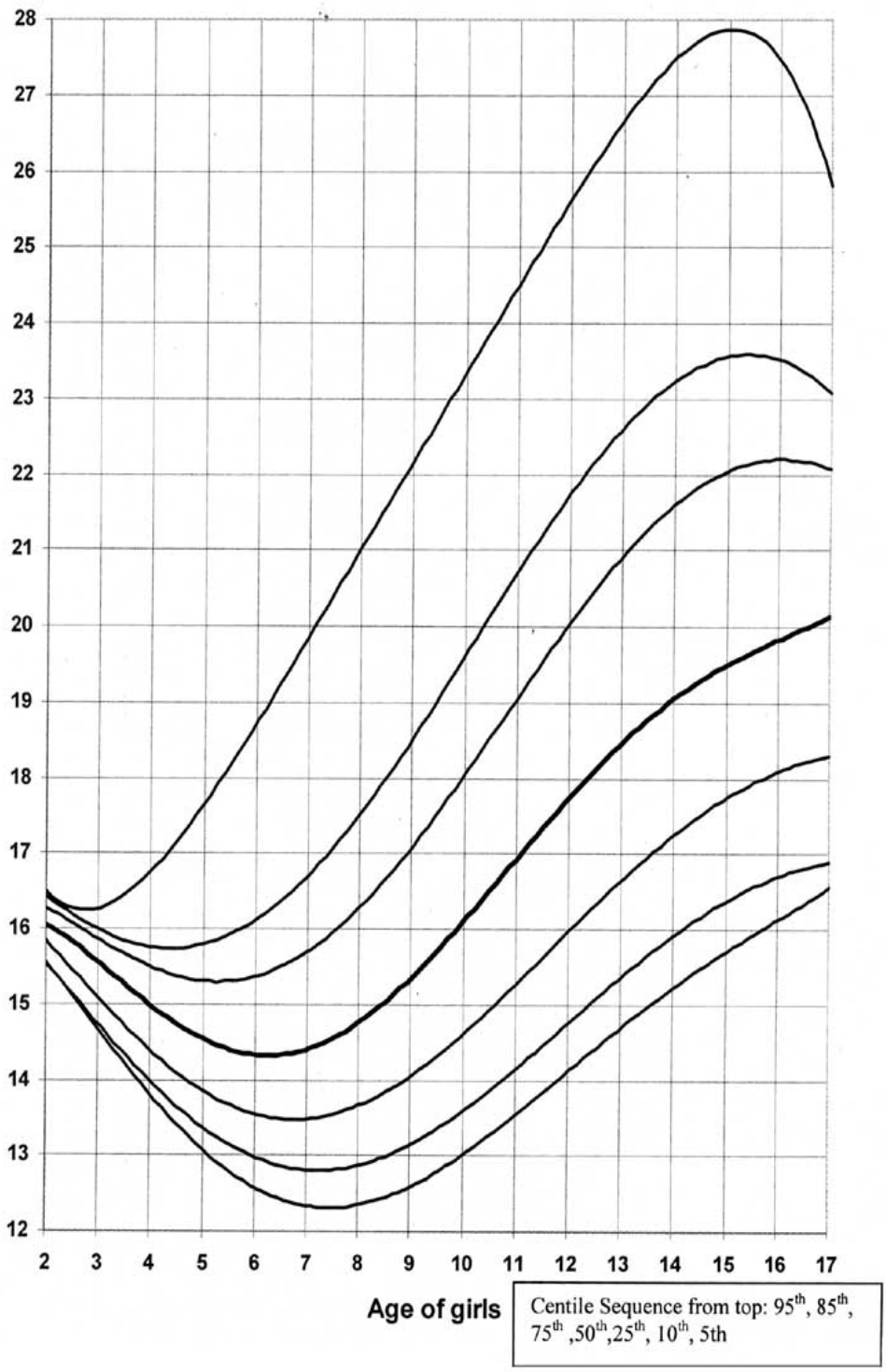
APPENDICES

Appendix A. Body mass index of non-obese and obese preschool boys as per IAP centile sequence



Appendix B. Body mass index of non-obese and obese preschool girls as per IAP centile sequence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17
Age of girls
Centile Sequence from top: 95th, 85th, 75th ,50th,25th, 10th, 5th

Appendix C: Questionnaire

Part I

Nutritional Assessment of Preschool Children and their Parents

Interview Schedule: _____

Interviewer: Miss.Saadia Khan
(MSc Nutrition & Dietetics)
PGRC
ANGR Agricultural University
Rajendranagar, Hyderabad.

Date of Interview:

1. General Information:

Name of the child:
Date of birth: Age: Gender:
Name of the School:
Class studying in:
Residential address:

Family Composition:

Name	Relation	Age	Sex	Education	Occupation	Income

2. Anthropometric measurements of Child & Parents:

S.no	Name	Height	Weight	MUAC	TSF	BMI	IBW

3. Details of the Child:

1. What was the birth weight of your child: _____ kg's.

a. less than 2.5 kgs
b. 2.5 – 3.0 kgs
c. 3.0 – 4.0 kgs
d. Above 4 kgs

2. Was the child fed colostrum at birth and in the next first 2-3 days? Yes/ No

3. Was the child breast fed? Yes/No

If yes, a. less than 6 months b. less than 3 months
c. up to 1 year d. up to 2 years

4. If not breast fed, what was the child fed with

a. fresh cow's milk b. fresh buffalo milk
c. toned dairy milk d. commercial formula

5. When did you start other foods, in addition to breast milk

a. 4 th month onwards b. 6 th month onwards
c. 1 year onwards d. Any other , specify

_____

6. What was the food given in supplementation to the milk.

a. Ceralax , farex etc b. Home prepared gruels
c. Rice and dhal d. Normal home food

If any other specify:

7. Who was looking after the child during day time?

1. below 1 year

a. mother b. crèche c. grandmother d. housemaid e. any other, specify _____

2. 1- 2 year

a. mother b. crèche c. grandmother d. housemaid e. any other, specify _____

3. 2-3 years

a. mother b. crèche c. grandmother d. housemaid e. any other, specify _____

8. 24 hour food intake recall:

For day 1st ,2nd and 3rd .

Timings /Meal	Food served & quantity (cups, tablespoons, teaspoons etc)	Ingredients	Quantity

9. What is the child's daily routine activity? (24 hr)

Timings (mins) From ---- To	Activity

10. Please read the following statements and tick the appropriate ones:

	Never	Rarely	Sometimes	Often	Always
Is the child physically active					
Do you allow the child to play outdoors					
Does the child take part in school games and physical activities					
Does the child readily take part in activities on his/her own					
Does the child need constant motivation to be active					
Does the child immediately go off to sleep after coming back from school					
Does the child use computer for more than 2 hrs					
Does the child play video games for more than 2 hrs					
Does the child sit in front of TV for more than 2 hrs					
Does the child eat snacks while watching TV					
Does the child gets influenced by TV food commercials					
Does the child consume soft drinks, beverages etc on a daily basis					
Does the child binge on high caloric foods in between meals					
Does the child binge on high caloric foods throughout the day					
Is the child a voracious eater					

11. The child's hours of undisturbed sleep during school days: _____

Part II

Assessment of Mother's Nutritional Status:

Name: Age: Age at marriage:

Age at 1st pregnancy: 2nd pregnancy: 3rd pregnancy:

Height: _____ cms/inches Weight: _____kg's

Occupation:

1. What was your weight just before pregnancy? _____ kg

2. What was your weight after the child was 6 months old? _____ kg

3. Did you go for any exercise during your pregnancy? Yes / No

If yes, specify:_____

4. What kind of delivery it was? _____

a. normal b. cessarian section c. other, specify

5. Were you over weight at any stage during your childhood?

Yes /No/ don't know

6. If yes, tick the appropriate period

a. first 1 year
b. 2-4 years
c. 5-7 years
d. 8-10 years
e. 11-13 years
f. 14 -16 years
g. 17-19 years

7. If you have gained weight after deliveries, when did you start putting on excess weight?

a. 15 – 20 years b. 20- 25 years c. 25- 30 years d. 30 -35 years e. > 35 years

What do you think is the reason for excess weight gain in your case?

8. Are you suffering from any chronic health complication?

Problem	Suffering from which age	Treatment , if any
Blood pressure Juvenile Diabetes mellitus Gestational Diabetes mellitus Joint pains / arthritis Gall bladder stones Hypothyroidism Any other health problems, specify:		

9.What is your present daily routine activity? (24 hr)

Timings (mins) From ---- To	Activity

10. <u>24 hour food intake recall:</u>

For day 1st ,2nd and 3rd .

Timings /Meal	Food served & quantity (cups, tablespoons, teaspoons etc)	Ingredients	Quantity

11. Dietary practices: (tick the appropriate ones)

a. Only vegetarian
b. Non – vegetarian
c. Eggarian
d. Alcoholic
a. Non alcoholic
b. Ex alcoholic

12. How often do you eat outside the house?

Frequency	Meal	frequency
1. Everyday	Breakfast	( )
2. Once in a week	Lunch	( )
3. Twice in a week	Snacks	( )
4. 3-4 times in a week	Dinner	( )
0. Never		

12. Which are the food items eaten at home most of the time?

Breakfast items:

Lunch items:

Snacks items:

Dinner items:

13. Which oil/ fat is generally used for cooking?

14. What is the approximate amount of oil used per month?

15. Which milk do you use?

16. What are the usual special family foods for celebrations?

17. What are the usual foods served in the school tiffin box

Items

Set – II Answer the following, put a tick mark

1. Children are considered obese if they have
   a. excess of muscle mass
   b. excess of fat accumulation
   c. deficiency of any vitamin

2. The dietary practices that lead to obesity are
   a. excess intake of food
   b. excess intake of high caloric foods
   c. decreased energy expenditure(physical activity)
   d. all the above

3. Ideal Body Weight norms for children are given as follows:
   a. weight for gender
   b. weight as per hereditary
   c. weight for age

4. The degree of body fat in children can be assessed from
   a. thickness of skin folds
   b. chest circumference
   c. body weight alone

5. The child is considered as overweight if his current weight is ____ % excess to his ideal body weight
   a. 5%
   b. 10%
   c. 15%
   d. 20%

6. The child is considered as obese if his current weight is ____ % excess to his ideal body weight
   a. 10%
   b. 20%
   c. 30%
   d. 50%

7. Following doesn't promote weight gain
   a. playing outdoors
   b. watching TV
   c. sleeping for long hours

8. Which of the following requires less energy expenditure?
   a. bicycling
   b. running
   c. playing indoors

9. Which of the food items given below is most nutritious for children?
   a. potato chips
   b. pudding
   c. pastries

10. In a day, how many times a child should eat
   a. two heavy meals a day
   b. small meals with 2 – 2 ½ hours intervals
   c. three meals a day

11. A child taking adequate food without any physical activity may maintain:
    a. ideal body weight
    b. underweight
    c. overweight

12. Likelihood of obese child growing to an obese adult is
    a. more
    b. less
    c. not sure

13. Many obese children may suffer from nutritional deficiencies like
    a. PEM (protein energy malnutrition)
    b. Anemia
    c. Night blindness

14. Childhood obesity may likely increase the risk of the following during adulthood
    a. diabetes mellitus
    b. high blood pressure & heart diseases
    c. gall stones
    d. all the above

15. The good sources of energy in our diet are
1. Cereals & pulses 2. Butter, oil & ghee 3. Sugar & jaggery 4. Vegetables & fruits 5. Milk and fish
    a. 1 &3
    b. 1,2,3
    c. 4 & 5
    d. 5

16. Excess of energy intake is stored as
    a. muscle protein
    b. body fat
    c. blood glucose

17. Highest caloric content per 10 gm of food is found in
    a. oil/ghee
    b. rice
    c. sugar

18. Following gives you instant energy
    a. carrot
    b. fruit juice
    c. roti

19. Which of the following animal food provide low fat
    a. mutton
    b. fish
    c. liver
20. Which foods contain fiber
    a. vegetables & fruits
    b. millets & pulses
    c. all

21. Fiber is needed for
    a. releasing energy instantly
    b. moderately quicker digestion of food
    c. release energy slowly and promote bowel movement

22. Which foods are best to avoid in the diet of an obese child
    a. fruit salads
    b. milk
    c. concentrated sweets and cool drinks

23. Which of the following fluids provide empty calories
    a. fruit juices
    b. cool drinks
    c. milk

24. Will a vegetarian diet alone provide the child all the nutrients required
    a. yes
    b. no
    c. not sure

25. The best way of maintaining ideal body weight among children
    a. balanced diet as per requirements and physical activity
    b. put the child on purgative
    c. fasting once / twice a month

26. Physical exercise helps the body to utilize
    a. body fat
    b. body muscles
    c. blood and cellular fluids

27. For nutritional school lunch, select
    a. biscuits & chips
    b. bread and jam
    c. vegetable khicidi

28. Less energy expenditure than energy intake results in
    a. positive energy balance
    b. negative energy balance
    c. zero energy balance

29. Which of the following exercise, consume more energy in children
    a. doll playing/ indoor play
    b. swimming/ dancing
    c. playing hide & seek/ swinging

30. The best approach for counseling for correction of childhood obesity is
    a. nutritionist & exercise experts
    b. doctor & family counselor
    c. teachers & children's films

Give your opinion by ticking the appropriate for the following statement

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Obesity in children is due to excess liquid accumulation due to nutrient imbalance					
The percent of body fat increases with decrease in physical activity					
It is sufficient to monitor child's weight once in 6 months					
Obesity or overweight need not be a concern if the child is physically active					
Childhood obesity is the foundation for obesity in adulthood					
It is the type(kind) of food but not the quantity of food that initiates obesity in children					
An obese child may sometimes suffer from a vitamin or mineral deficiency					
Mothers are usually knowledgeable about how much food the child needs for maintaining weight					
Carbohydrates and fats are the main source of energy in the child's diet					
Empty calories from cool drinks affect mineral absorption					
Excess oils and fats in the child's diet trigger fat accumulation					
Feeding colorful fruits and vegetables regularly makes the child voracious and increase body weight					
Maintenance of 2 or 3 meal timings is important for weight management					
Child consuming heavy snacks in between his/her meals is a good habit					
If the child demands for high caloric food always, he should be obliged					
Parents often get influenced by food advertisements on TV and promote the same among the children					
A strict schedule of physical activity and not a free outdoor play help the child in weight reduction					
Allowing the child to watch TV while giving food makes the feeding easier for the mothers & promotes child's food intake					
Excess of weight during childhood can lead to health complication in his/her future life					
Consulting a nutritionist regarding the child's excess weight is like insulting the child					
Adding lot of ghee in child's food is a must as it promotes strength & growth of the child					

Tick one/ more usual practices with your child

1. How often is the child weighed? _____. Who takes the weight? _____.

2. Feeding the child is done by
a. mother b. child itself c. grandmother d. child's attendant

3. A variety of foods should be included in once diet. Hence I serve lot of variety foods to the child.
a. agree b. partially agree c. disagree

4. Number of feeds for the child per day

A. milk & milk products
a. no fixed number, but on demand b. twice a day c. thrice a day d. 4 times a day

B. meals
a. no fixed number, but on demand b. one meal a day c. two meals d. three meals

C. breakfast items fed
a. no fixed number, but on demand b. once in morning c. mid morning
d. twice a day e. thrice a day

D. number of times the child is fed snacks
a. no fixed number, but on demand b. once c. twice d. thrice

Order of preference Frequency
Quantity

1.daily	2.alternate	3.weekly	4.fortnightly	5.occasionally	6. never

1. milk and milk products

(plain milk, Horlicks / complain ,
coffee, tea,milk shakes, rasgulla,
gulab jamun, rasmalai, paneer
preparations, lassi, curd, pudding,
ice- cream, soya milk – plain,
malt, flavoured, badam milk,
shrikand, any khoa products etc)
Any other:

2. fruit & fruit products

(fresh fruits, canned fruits, fruit juices,
dry fruits, fruit cakes, fruit milk shakes,
fruit biscuits etc)
Any other:

3. beverages

(coconut water, sugarcane juice,
maaza, fruity, sprite, cola drinks,
soda water, lime juice, rasna,
tang, squashes, smothies etc)
Any other:

4. bakery & confectionery

(biscuits, cakes, hot chips,
chocolate pastries, muffins,
sugar candies, sweet buns,
brown bread, Cadbury, choclates etc)
Any other:

5. sweet preparations

(jalebi, laddu, rasgulla, gulab jamun,
khalakhand, rasmallai, etc
Any other:

Continue, if any more

5. Are there any foods hidden from child's reach? Yes/ No

If yes, what are those foods and why

8. Generally, is the child interested in food and eating? Yes/No
9. How long does the child eat patiently
   a. 15 min
   b. 30 min
   c. 45 min
   d. Any other

10. How often the child is forced to complete the plate
a. always b. once/twice a day c. never d. occasionally

Part III

Assessment of Father's Nutritional Status:

Name: Age: Age at marriage:

Height: Weight:

Occupation:

1. Were you over weight at any stage during your childhood?

Yes /No/ don't know

If yes, tick the appropriate period

1. first 1 year
2. 2-4 years
3. 5-7 years
4. 8-10 years
5. 11-13 years
6. 14 -16 years
7. 17-19 years

2. If you are overweight / obese presently, when did you start putting on excess weight?

1. 20-30 years
2. 30 -40 years
3. 40 – 50 years
4. 50 -60 years
5. before marriage
6. after marriage
7. after any surgery, specify_____

3.Are you suffering from any chronic health complication?

Problem	Suffering from which age	Treatment , if any
Blood pressure Stroke Heart disease Diabetes mellitus Joint pains / arthritis Gall bladder stones Hypothyroidism Any other, specify		

4. What do you order when the family goes out for eating?

Breakfast:

Lunch:

Snacks:

Dinner:

5.What is your present daily routine activity? (24 hr)

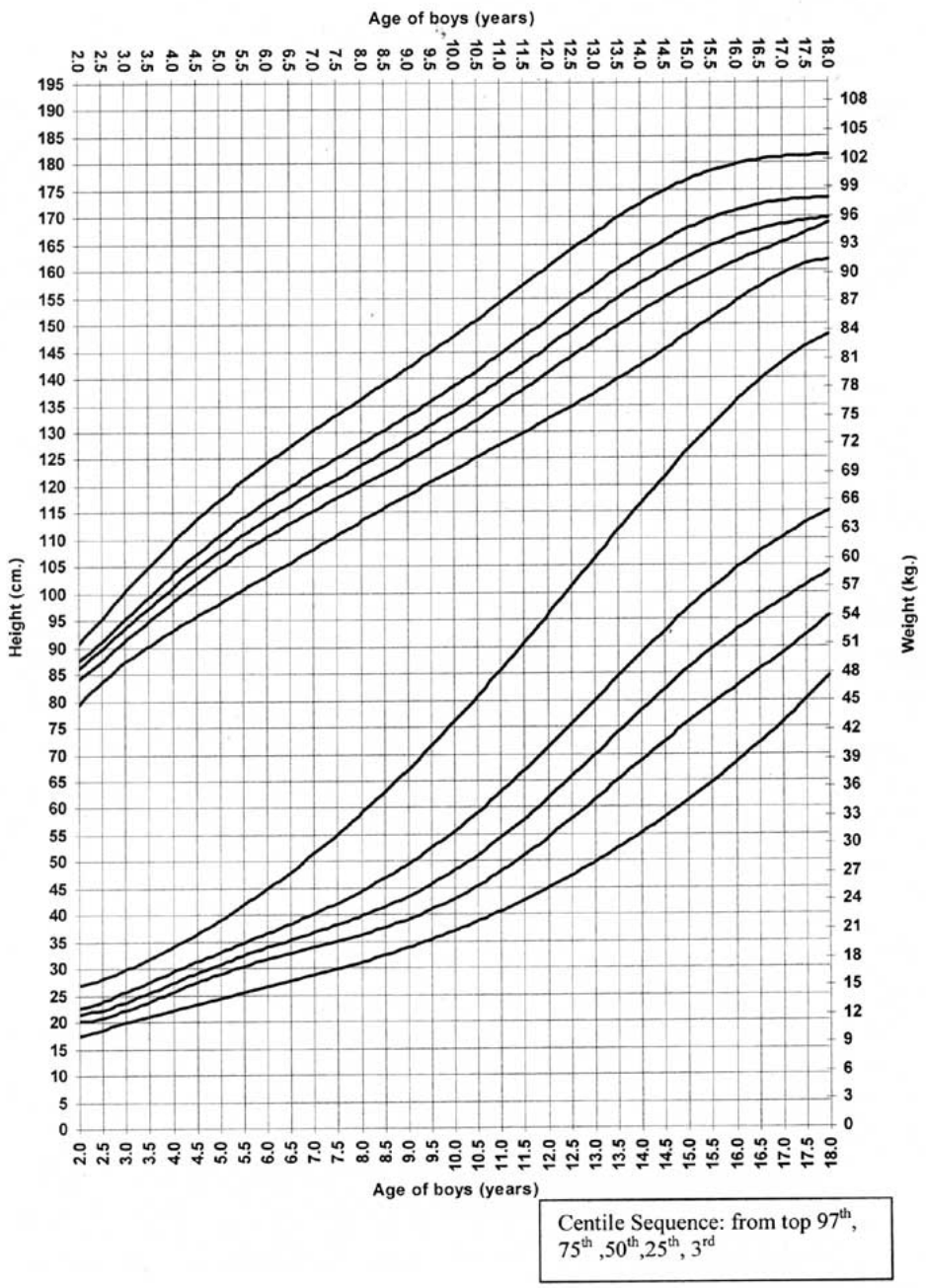
Timings (mins) From ---- To	Activity

6. <u>24 hour food intake recall:</u>

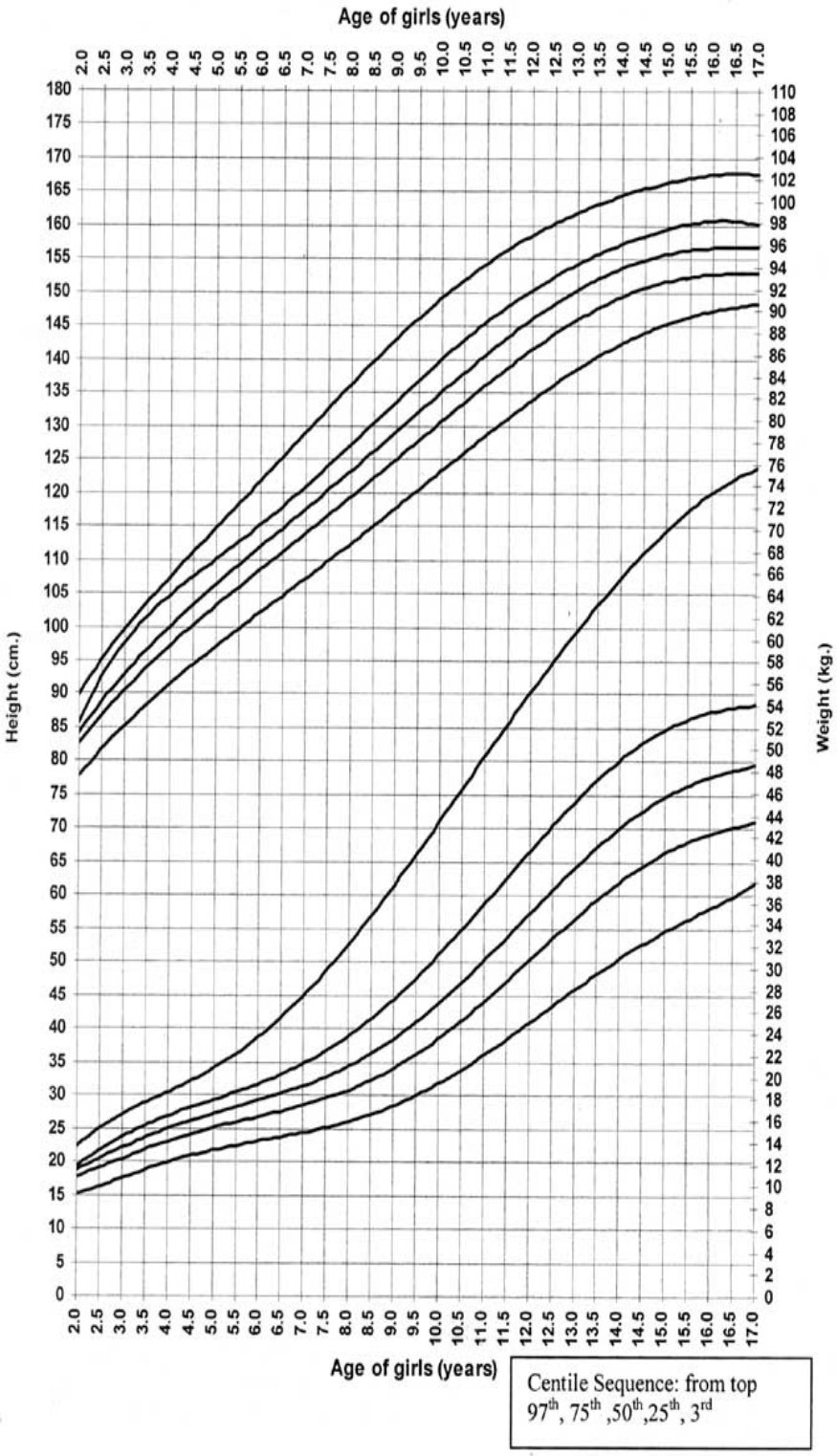
For day 1st ,2nd and 3rd .

Timings /Meal	Food served & quantity (cups, tablespoons, teaspoons etc)	Ingredients	Quantity

Appendix D: Height for weight for age of non-obese and obese boys as per IAP



Appendix E: Height for weight for age of non-obese and obese girls as per IAP


Age of girls (years)
2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0
Height (cm.)
180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0
Weight (kg.)
110 108 106 104 102 100 98 96 94 92 90 88 86 84 82 80 78 76 74 72 70 68 66 64 62 60 58 56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
Age of girls (years)
Centile Sequence: from top
97th, 75th ,50th ,25th, 3rd

Appendix F. Percent correct responses of mothers of non-obese and obese preschool children on knowledge related to childhood obesity

S.no	Questions	Correct Response of Mothers of obese children	Correct Response of Mothers of non obese children
1.	When are children considered obese	83%	77%
2.	The dietary practices that leads to obesity	47%	37%
3.	Ideal Body Weight norms for children	73%	83%
4.	Method of assessing the degree of body fat in children	33 %	30%
5.	When is the child considered as overweight - in terms of weight	47%	30%
6.	When is the child considered as obese - in terms of weight	27%	33%
7.	Activity which doesn't promote weight gain	87%	87%
8.	Activity which requires less energy expenditure	90%	90%
9.	Is pudding nutritious for children	70%	70%
10.	In a day, how many times a child should eat	53%	37%
11.	A child taking adequate food without any physical activity may maintain his ideal body weight	73%	77%
12.	Likelihood of obese child growing to an obese adult	60%	57%
13.	Obese children may suffer from nutritional deficiencies	30%	23%
14.	Childhood obesity may likely increase the risk of cardiovascular diseases, diabetes during adulthood	67%	53 %
15.	The good sources of energy in our diet	23%	30%
16.	Storage form of excess energy intake in the body	80%	87%
17.	Food with highest caloric content per 10 gm	57%	60%
18.	Food which gives you instant energy	77%	83%
19.	Which animal food provide low fat	97%	100%
20.	Which foods contain fiber	63%	50%
21.	Fiber is essential	57%	63%
22.	Foods which are best to avoided in an obese child's diet	90%	93%
23.	Which fluids provide empty calories	70%	77%
24.	A vegetarian diet alone provide the child all the nutrients daily required	30%	23.3%
25.	The best way of maintaining ideal body weight among children	97%	93%
26.	Importance of physical exercise	83%	83%
27.	Nutritional school lunch	80%	83%
28.	Less energy expenditure than energy intake results in	47%	13%
29.	Which exercises consumes more energy in children	80%	63%
30.	The best approach for counseling for correction of childhood obesity	70%	30%

Appendix G: Food items ordered when eating out

Meals	Non-obese family	Obese family
Breakfast	Idly, dosa,puri, upma, vada	Idli, dosa, vada, puri
Lunch	Rice, veg curries, chapatti, chinesse, noodles, non-veg, veg soups, veg meals	Rotie, veg curries, rice, non-veg, pasta, mutton, chicken, prawns
Snacks	Tea, biscuits, fruit salads, ice-cream, mixture, pop corn, cutlets, puffs, samosa	Chaat, pizza, burger, pani puri, sandwich, patties, samosa, tea, coffee, curry puffs, ice cream, juices, bhel puri, ragda, cool drinks, mirchi bhajji's
Dinner	South Indian thali, ice cream, chinesse, veg pulao, biryani, hares, puri, non-veg, salads, sea food, noodles, pizza/burger, haleem	Soups, starters, rice, chapatti, non-veg curries, moghali foods, fried chicken, fried rice, pizza, biryani, ice cream, fish

Appendix H: Food items prepared at home most

Meals	Non-obese family	Obese family
Breakfast	Roti,khichdi, dosa, idli, cereals, parathas, egg, upma, poha, puri, uttampam, egg sandwich,milk, minced meat, non-veg, bread, muesli, veg cutlets.	Chapatti, veg curries, egg, salad, cereals, odli, upma, dosa, puri, poha, khichdi, roti, bread, magi, dhals, fruits, sandwich, muesli. Cornflakes, milk , fruits.
Lunch	Rice, roti, non-veg, vegetables, samber, rasam, curd, khichdi, veg salads.	Rice, dhal, non-veg, curdm moghlai foods, papads, fish, carrots.
Snacks	Tea, pakodi, fruits, biscuits, fruit juices, bhel puri, salads, samosa, mirchi bhajji, chudwa, grilled sandwich, soups, namkeen, macroni.	Samosa, curry puffs, chips, pani puri, chat, pizza, burger, pakoda, French fries, biscuits, ice-cream, popcorn, bhajji's, chicken nuggets, soups, fruits, salads, KFC, cutlet, chips, murkel, puri, chudwa, bread, pakodi, bread butter, bakery items.
Dinner	Roti, rice,vegetable curries, khichdi, tomato rice, biryani, sweets, papads, veg salads, curd, sea food.	Rice, curries, biryani, chapatti, fish, noodles, curd.
Special food for occasion	Biryani, pudding, rice, varieties, sweet preparations,halwas, payasam, non-veg ,pongal, puran pohli, khoa puri, shrikandh, chikki, coconut rice, laddu, sweets, chicken and mutton reciepes, pulao, fish dishes, tandori, ice cream, kheer, pulihora, vada, fruit salad, pizza, fast foods, tradional foods, chinesse, carrot halwa, paneer items.	Biryani, chicken-varieties, fruit salad, qurbani sweet, qubuli, haleem, bread sweet, pudding, parathas, khorma, kheerm payasam, pulihora, sweet roti, tamarind rice, pongal, veg fried rice, moghlai, fruit custard, veg pulao, siji halwa, chole puri, sjeer kurma, tahari, mutton, pastas, wada, cakes, paneer butter masala, prawns, gulab jamun, pizza,sea food, chinesse.