

# **MODIFIABLE RISK FACTORS FOR OBESITY IN ADOLESCENCE**

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# *Certificate*

*Certified that this dissertation entitled “**MODIFIABLE RISK FACTORS FOR OBESITY IN ADOLESCENCE**” is a bonafide work done by **Dr. A. Karthikeyan**, Post Graduate Student of Pediatric Medicine, Institute of Child Health and Hospital for Children, Egmore, Chennai - 600 008, during the academic years 2005 – 2008.*

**PROF. DR. T. JOTHI**  
**M.D., D.C.H.,**  
*Additional Professor of Pediatrics,*  
Institute of Child Health and  
Hospital for Children,  
Madras Medical College,  
Chennai.

**PROF. DR. SARADHA SURESH**  
**M.D., Ph. D., FRCP (GLAS)**  
*Director and Superintendent,*  
Institute of Child Health and  
Hospital for Children,  
Madras Medical College,  
Chennai..

**Prof. Dr. T.P. KALANITI M.D.,**  
Dean,  
Madras Medical College  
Chennai - 600 003.

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# Introduction

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# INTRODUCTION

Obesity is an emerging major public health problem throughout the world<sup>1</sup> and its prevalence has largely increased over the last decade in both developed and developing countries<sup>2</sup>. While this global epidemic is well described in the adult population, not much data is available regarding the risk factors for obesity in adolescents among the developing countries.

Developing countries are undergoing nutrition transition due to increased economic development and market globalization leading to rapid changes in lifestyle and dietary habits<sup>3</sup>. World health organization has declared obesity as one of the most neglected disease of significant public health importance of this century<sup>4</sup>.

## **OBESITY: OVERVIEW OF AN EPIDEMIC**

Obesity is a monumental dilemma affecting the health and well-being of the world's population<sup>5, 6</sup>. This is not a new problem, but rather a rapidly increasing one among children, adolescents and adults<sup>7</sup>. The reasons for this escalation are multi-factorial; each must be appreciated and precisely addressed before solutions to Obesity are practical<sup>8</sup>. Increase in obesity rates are being seen among boys and girls of



adolescent age of all ethnic groups, of all ages, and of all educational and socioeconomic levels. The National Health and Nutrition Examination Surveys (NHANES cycles I, II & III) have been surveying the prevalence of Obesity in American children and youth since 1971. The 1988-91 NHANES cycle III study identified 21% of adolescents 12-19 years of age as being overweight (using BMI or body mass index as criteria) up from 15% in the 1966-80 NHANES II study<sup>9</sup>.

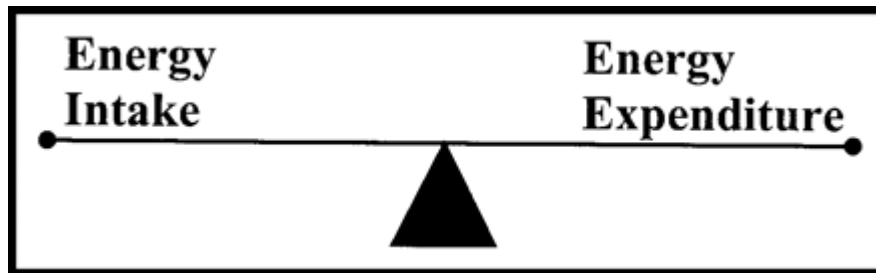
Though more studies are needed to understand the precise prevalence of overweight and Obesity in India, school-based data demonstrates an Obesity<sup>10, 11, 12</sup> range of 5.6% to 24% for the children and adolescents in India

## **HOW DID THE EPIDEMIC AROSE**

To maintain a stable weight, energy intake must overtime exactly equal energy expenditure. This is called energy balance equation. Whenever energy intake exceeds energy expenditure positive energy balance results resulting in weight gain. Further the physiological regulation of energy balance is weak against chronic changes in food intake or physical activity and the physiological system is more biased to protect against body weight loss than weight gain. As the environment gradually has changed to one where high levels of physical activity are

not required in daily life and where food is abundant, inexpensive and served in large portions, the physiological system appears to be insufficient to oppose weight gain and obesity<sup>41</sup>

### ENERGY BALANCE EQUATION



### RELEVANT ANATOMY

The adipocyte, which is the cellular basis for obesity, is increasingly found to be a complex and metabolically active cell. At present, the adipocyte is being perceived as an endocrine gland with several peptides and metabolites that may be relevant to the control of body weight, and these are being studied intensively. Among the products of the adipocyte involved in complex intermediary metabolism are cytokines, tumor necrosis factor-alpha, interleukin-6, lipotransin, adipocyte lipid-binding protein, acyl-stimulation protein, prostaglandins, adipsin, perilipins, lactate, adiponectin, monobutyryn, and phospholipid transfer protein.

Among critical enzymes involved in adipocyte metabolism are endothelial derived lipoprotein lipase (lipid storage), hormone-sensitive lipase (lipid elaboration and release from adipocyte depots), acylcoenzyme A (acyl-CoA) synthetases (fatty acid synthesis), and a cascade of enzymes (beta oxidation and fatty acid metabolism).

### **THE THRIFTY GENE HYPOTHESIS**

The thrifty gene hypothesis is a hypothesis proposed in 1962 by geneticist James Neel to explain the tendency of certain ethnic groups, to tend towards obesity and diabetes. It postulates that certain genes in humans have evolved to maximize metabolic efficiency, lipid storage and food searching behavior, and that in times of abundance these genes predispose their carriers to diseases caused by excess nutritional intake, such as obesity.

In the past, this genotype would have been advantageous during periods of famine. However, with the advent of high fat, high carbohydrate, and low fiber diets, and relative inactivity this genotype is no longer advantageous because it is too efficient. This has led to obesity and related health problems.

It follows from the theory that ethnic groups with a history of food scarcity will have undergone a relatively high evolutionary pressure and hence may harbor more thrifty genes than other populations.

It is often cited alongside the thrifty phenotype hypothesis (or Barker hypothesis) as an explanation for progressive prevalence of obesity.

### **THE PROBLEM OF OBESITY IN ADOLESCENTS**

- Risk factors for heart disease, such as high cholesterol and high blood pressure, occur with increased frequency in overweight children and adolescents compared to children with a healthy weight.<sup>19</sup>
- Type 2 diabetes, previously considered an adult disease, has increased dramatically in children and adolescents. Obesity is closely linked to type 2 diabetes.
- Obese adolescents have a 70% chance of becoming overweight or obese adults. This increases to 80% if one or more parent is overweight or obese. Overweight or obese adults are at risk for a number of health problems including

heart disease, type 2 diabetes, high blood pressure, and some forms of cancer.

- The most immediate consequence of overweight as perceived by the children themselves is social discrimination. This is associated with poor self-esteem and depression.

## **METABOLIC SYNDROME**

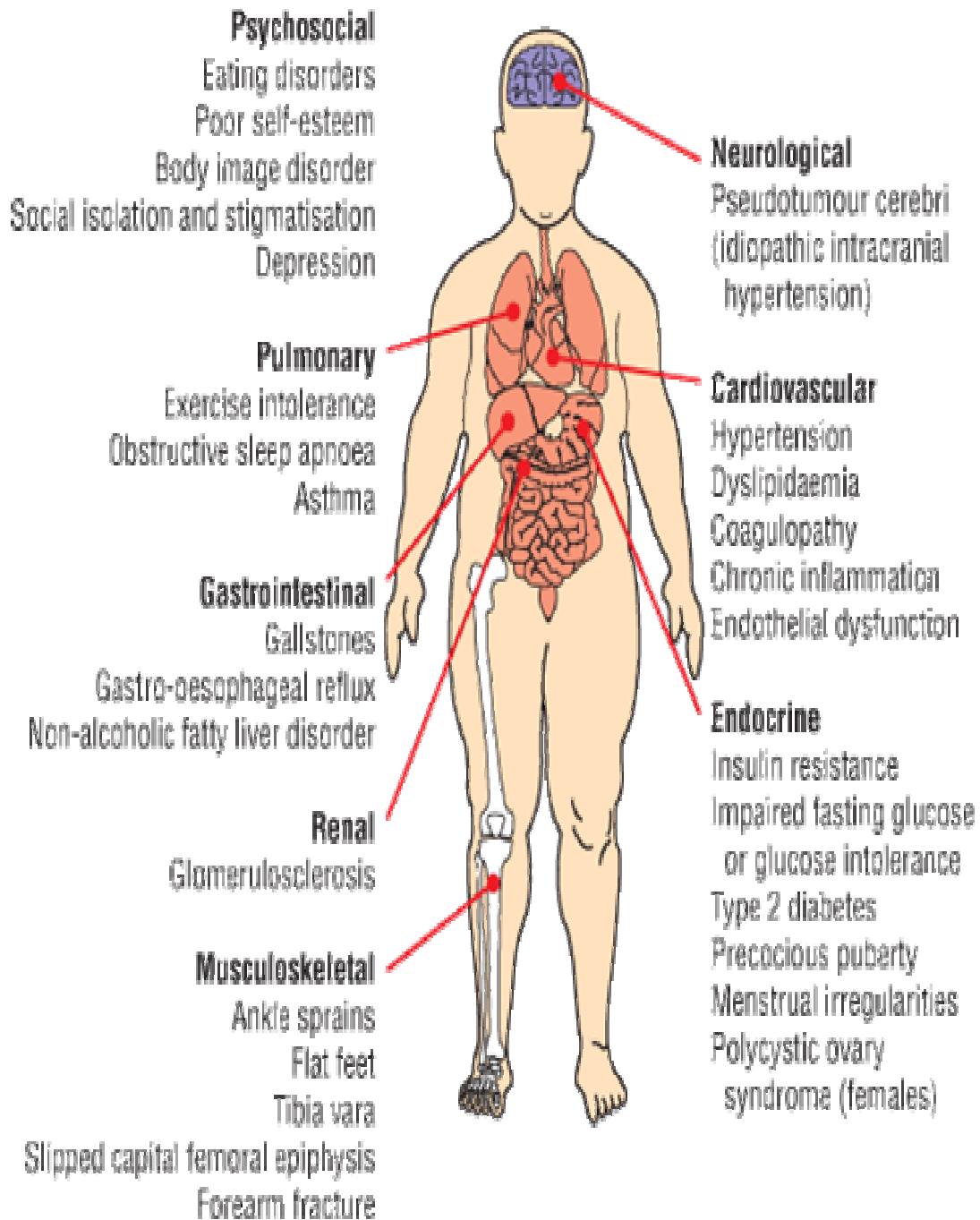
This syndrome consists of

- 1) Obesity
- 2) High fasting triglycerides
- 3) Impaired glucose tolerance
- 4) Hypertension
- 5) Low HDL (high density lipoprotein)

Its prevalence in adults is approximately 20% of individuals  $\geq 20$  years of age and 40% of the population  $>40$  years of age). This syndrome has a high predictive value for the development of diabetes and cardiovascular disease.

It is thus of great concern that this syndrome is being diagnosed in adolescents in increasing numbers. Thus Duncan et al have shown a significant increase in this syndrome in adolescents over the past decade (4. 2% in 1988–1992 to 6. 4% in 1999–2000). Moreover, the syndrome was found in 32. 1% of obese adolescents (BMI  $\geq$ 95<sup>th</sup> percentile for age and sex).

## COMPLICATIONS OF OBESITY IN CHILDREN AND ADOLESCENTS



## **CRITICAL PERIOD FOR ABNORMAL WEIGHT GAIN- ADOLESCENCE**

Adolescence, the transitional period that begins with puberty, is marked by dynamic physiological and psychological changes in both boys and girls<sup>13</sup>. Changes that occur in body composition during adolescence have been well characterized and demonstrate sexual divergence. Specifically, in boys, fat-free mass tends to increase, and body fat as a percentage of body weight decreases. In girls, both fat and fat-free mass increase, and fat-free mass as a percentage of body weight decreases<sup>14</sup>. In addition to alterations in total and percentage of body fat during adolescence, patterns of fat distribution also change. Mediated in part by hormonal influences, patterns of fat distribution during this developmental period also demonstrate sexual differences. Pronounced centralization of fat stores with increases in subcutaneous fat and visceral fat in the abdominal region occurs in boys; this pattern is similar but less dramatic for girls<sup>15</sup>.

In addition, fat tends to be deposited peripherally in the breasts, hips, and buttocks in girls during this period. Noteworthy is that the risk of becoming obese during adolescence appears to be higher among girls than it is among boys. Other observations suggest that up to 70% of obese adolescents will become obese adults. Adolescence has also been



emphasized as a critical period for the development and expression of obesity-related co-morbidities in both sexes.<sup>16-18</sup>

## **NEUROENDOCRINOLOGICAL SIGNALS OF WEIGHT REGULATION**

The hypothalamus regulates energy balance and food intake. Leptin, an adipocyte (fat cell) hormone, and insulin, both present in proportion to fat stores in the body, have a high density of receptors in the hypothalamus. The presence of leptin and insulin activates the anorectic branch of the hypothalamus (which decreases food intake) and inhibits the orexigenic branch (which stimulates food intake).

Hypothalamic signaling of leptin and melanocortin plays a key satiety role in regulating food intake and energy expenditure. Obese persons exhibit a consistent increase in blood levels of leptin, but feeding behaviors are not suppressed, implying a conditioned resistance to leptin. Conversely, the absence of these hormones activates the orexigenic branch and inhibits the anorectic branch, increasing food intake.

In addition, peripherally generated signals such as low plasma glucose, cortisol, and the recently discovered hormone ghrelin also increase food intake.

## **DEFINING OVERWEIGHT/OBESE IN ADOLESCENTS**

<i>Obese</i>	<i>BMI-for-age and sex &gt;95th percentile</i>
<i>Risk of obese or overweight</i>	<i>BMI-for-age and sex: 85th to 95th percentile</i>

## **DETERMINANTS OF OBESITY IN ADOLESCENTS**

Obesity is a polygenic disorder that results from the influence of multiple genetic and environmental factors. <sup>58</sup>Dramatic increase in obesity over the past several decades suggest the predominance of influential environmental factors over genetic factors. Though genes can impact each component of energy balance and can explain the differences between individuals in body weight and body composition<sup>42</sup>, they only have a permissive effect for weight gain. Genetic factors influence the susceptibility of a given child to an Obesity conducive environment. However, environmental factors, seem to play major roles in the rising prevalence of Obesity worldwide.<sup>21-24</sup> In a small number of cases, adolescent Obesity is due to genes such as leptin deficiency or medical causes such as hypothyroidism and growth hormone deficiency or side effects due to drugs (e. g. steroids). Most of the time, however, personal lifestyle choices and cultural environment significantly influence obesity.

The environmental risk factors which are modifiable are classified broadly into

- 1) Dietary pattern.
- 2) Behaviours related to eating.
- 3) Physical activity.
- 4) Sedentary life style.

#### **1) DIETARY PATTERN**

Nutritional surveys show that obesity levels relate to the amount of fat consumed. Studies of dietary preference have shown that normal-weight people crave high-carbohydrate foods, while obese people crave high-fat foods<sup>45</sup>. Adolescent population eat approximately one third of meals outside the home, often at fast-food restaurants, where fat constitutes 45% to 55% of most food selections' caloric content<sup>46</sup>. The physiological response to high-fat meals suggests that fat intake should suppress appetite (i.e., delayed gastric emptying). However, the reverse appears to be true. The effects of nutrients on satiation and satiety have been much studied recently. Satiation corresponds to the suppression of hunger after the ingestion of a certain amount of food whereas satiety describes the period of time of absence of hunger between meals. It is

important to assess the satiating capacity of the nutrients because the ability of the different macronutrients to stimulate satiety and to suppress subsequent food intake is not equal. There is a hierarchy in the ability of the three macronutrients to suppress subsequent food intake. Proteins have the greater satiating capacity; carbohydrates, which are also able to decrease the amount of food ingested at the next meal, follow them. By contrast, lipids have a less potent satiating effect than proteins and carbohydrates. Meals with a high lipid content favor passive over-consumption because the high-energy density promotes energy intake. In addition, the fat-induced appetite control signals are too weak to prevent excessive energy intake from a fatty meal. As a result, individuals consuming high-fat foods are more likely to gain weight. The passive over-consumption of high-fat diets is also due to the fact that people tend to consume a similar bulk of food regardless of its composition. With high-fat, energy-dense diets more calories are passively ingested than with high carbohydrate diets. The improved taste and texture of fatty foods further enhance the increased energy consumption of high-fat diets. Parents influence their children's eating habits by their example<sup>47</sup>. These habits tend to remain with the individual throughout adulthood

Consumption of sugar-sweetened beverages (SSBs), particularly carbonated soft drinks, may also be a key contributor to the epidemic of overweight and obesity, by virtue of these beverages high added sugar content, low satiety, and incomplete compensation for total energy.

## **2) BEHAVIOURS RELATED TO EATING**

Most obese adolescents do not overeat in any distinctive pattern. For a minority however two clear patterns have been identified : Binge eating disorder and Night eating syndrome. The other behavioural eating patterns associated with adolescent obesity are

- 1) To seek food in the absence of hunger

Eating in the absence of hunger (EAH) may be a behavioral trait through which obesity-promoting genes promote positive energy balance<sup>58</sup> Parental restriction of child food choices predicted increased EAH by girls<sup>59</sup>

- 2) Absence of a control over eating
- 3) To seek food in response to sadness, boredom and restlessness.
- 4) To seek food as a reward.
- 5) To sneak or hide food.

- 6) Binging and use of inappropriate behaviours like purging, fasting or excessive exercises.
- 7) To skip or delay breakfast
- 8) Evening hyperphagia
- 9) Night awakenings and binging
- 10) Frequent visits to fast food restaurants
- 11) Eating lunch or dinner in groups

### **3) PHYSICAL ACTIVITY**

Regular physical activity is a key factor in achieving and maintaining a healthy body weight. Physical activity may also favorably affect body fat distribution. Although young people are more active than adults are, many young people do not engage in recommended levels of physical activity<sup>35,36</sup>. In addition, physical activity declines precipitously with age among adolescents<sup>36</sup>. It has been hypothesized that a steady decline in physical activity among all age groups has heavily contributed to rising rates of Obesity all around the world<sup>36</sup>. Physical activity strongly influenced weight gain in a study of monozygotic twins<sup>30</sup>. In addition, increased proportions of children who are being driven to school and low

participation rates in sports and physical education, particularly among adolescent girls<sup>30</sup>, are also associated with increased Obesity prevalence. Adolescents are similar to adults in that regular exercise provides additional health benefits for Obese individuals, including prevention of future risk acquisition, improved insulin sensitivity, blood pressure reduction, and improved socialization through group participation in activities<sup>60</sup>.

The Centers for Disease Control outline the benefits of regular physical activity for children:

- Improves strength and endurance
- Helps build healthy bones, muscles, and joints
- Helps control weight, build lean muscle, and reduce fat
- Reduces anxiety and stress, increases self-esteem and overall energy level
- May improve blood pressure and cholesterol levels
- Prevents disease and promotes health

The 1993 International Consensus Conference on Physical Activity Guidelines for Adolescents states that

1. All adolescents should be physically active daily, or nearly every day, as part of play, games, sports, work, transportation, recreation, physical education, or planned exercise in the context of family, school, and community activities.
2. Adolescents should engage in three or more sessions per week of activities that last 20 minutes or more at a time and that require moderate to vigorous levels of exertion.

#### **4) SEDENTARY LIFE STYLE (LIKE TELEVISION VIEWING)**

Numerous studies have shown that sedentary behaviors like watching television and playing computer games are associated with increased prevalence of Obesity<sup>31</sup>. TV viewing, a sedentary behavior is conducive to obesity. The increased food consumption during television viewing is not only quantitative but also qualitative. Commercials on television showing advertisements for extra-large pizzas, huge containers of popcorns, super sizes of soft drinks, and massive quantities of other junk food also plays a significant role in causing Obesity among adolescents. Furthermore television watching can dishabituate eating or disrupt the development of habituation, which may provide a mechanism for increased energy intake associated with watching television<sup>33</sup>.



Furthermore, parents prefer to have their children watch television at home rather than play outside unattended because parents are then able to complete their chores while keeping an eye on their children<sup>37</sup>

### **BODY MASS INDEX (BMI)**

- Body Mass Index (BMI)<sup>20</sup> is an anthropometric index of weight and height (stature) that is defined as body weight in kilograms divided by height in meters squared. BMI is the commonly accepted index for classifying adiposity in adults and it is recommended for use with children and adolescents.

$$\text{BMI} = \text{weight (kg)} / \text{height (m)}^2$$

### **ADVANTAGES IN USING BMI-FOR-AGE<sup>51</sup>**

- 1) BMI is gender specific and age specific for children.
- 2) BMI-for-age is the measure used for ages 2 to 20 years since BMI changes substantially as children get older. Whereas for adults, BMI is neither age nor gender specific and nutritional status is defined by fixed cut points.
- 3) BMI-for-age provides a reference for adolescents that was not previously available.

- 4) BMI-for-age is the only indicator that allows us to plot a measure of weight and height with age on the same chart.
- 5) BMI-for-age is the measure that is consistent with the adult index so BMI can be used continuously from 2 years of age to adulthood. BMI can be used to track body size beginning at 2 years of age and continue throughout the life cycle. This is important since BMI in childhood is a determinant of adult BMI.
- 6) Another advantage of using BMI-for-age to screen for Obesity or at risk of overweight in children is that it correlates with clinical risk factors for cardiovascular disease including hyperlipidemia, elevated insulin, and high blood pressure.
- 7) BMI accurately reflects the proportion of excess body fat and correlates with markers of secondary complications of obesity and long-term mortality

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# Review of Literature

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## REVIEW OF LITERATURE

1) **Zuguo Mei, Laurence M Grummer-Strawn, Angelo Pietrobelli, Ailsa Goulding, Michael I Goran and William H Dietz**(2002) has concluded that for children and adolescents aged 2–19 y, the performance of BMI-for-age is better in predicting underweight and overweight but is similar to that of weight-for-height<sup>51</sup>

2) **Kerri N Boutelle**(2006) has stated that Fast-food purchases for family meals were positively associated with the weight status of the adolescents<sup>52</sup>

3) **Marcia Schmidt, MS, Sandra G. Affenito, et al** has concluded that fast-food consumption is associated with the development of obesity and cardiovascular risk factors in black and white female adolescents<sup>53</sup>

4) **P. K. Newby et al** The review specifically considers the roles of total energy intake and energy density; dietary composition; individual foods, food groups, and dietary patterns; beverage consumption; and eating behaviors and their association with adolescent obesity<sup>54</sup>

5) **Michael Kohn M. D et al**<sup>55</sup> has concluded that eating while watching television and the number of soft drinks consumed were significantly associated with obesity

6) **Mahshid Dehghan, Noori Akhtar-Danesh and Anwar T Merchant**<sup>25</sup> has concluded that over-consumption of calories and reduced physical activity are mainly involved in childhood Obesity.

7) **Joyce Giammattei, DrPH; Glen Blix, DrPH; Helen Hopp Marshak, PhD; Alison Okada Wollitzer, PhD; David J. Pettitt, MD**<sup>32</sup> has concluded that Time spent watching television and the number of soft drinks consumed were significantly associated with obesity

8) **Jennifer L Temple, April M Giacomelli, Kristine M Kent, James N Roemmich and Leonard H Epstein**<sup>33</sup> showed that television watching can dishabituate eating or disrupt the development of habituation, which may provide a mechanism for increased energy intake associated with watching television

9) **Vasanti S Malik, Matthias B Schulze and Frank B Hu**<sup>34</sup> Although more research is needed, sufficient evidence exists for public health strategies to discourage consumption of sugary drinks as part of a healthy lifestyle.

10) **Yang. z et al** has stated that Increased beverage consumption was associated with an increase in the total energy intake of the children and increase in their BMI<sup>38</sup>.

11) **Heather M. Niemeier Ph. D** (2006) has concluded that Fast food consumption and breakfast skipping increased during the transition to adulthood, and both dietary behaviors are associated with increased weight gain from adolescence to adulthood. These behaviors may be appropriate targets for intervention during this important transition<sup>39</sup>

12) **Hilda Chakar and Pascale R Salameh**<sup>43</sup> in 12299 adolescents, we found high prevalence of obesity (7. 5%) and at risk of obesity (24. 4%). In girls, risk of obesity and obesity prevalence decrease with increasing age ( $P < 10^{-4}$ ) as compared with that in boys.

13) **A Drewnowski, CL Kurth and JE Rahaim** Obese subjects characterized by large weight fluctuations showed elevated preferences for sugar and fat mixtures compared with the stable subgroup<sup>45</sup>

14) **Elsie M. Taveras et al** (2005) has suggested that older children who consume greater quantities of Fried food away from home have excess weight gain<sup>48</sup>

15) **Ram Weiss et al** in his study on the varying degrees of obesity on the prevalence of the metabolic syndrome and its relation to insulin resistance and to C-reactive protein and adiponectin levels in a large, multiethnic, multiracial cohort of children and adolescents. The prevalence of the metabolic syndrome increased with the severity of obesity and reached 50 percent in severely obese youngsters. Each half-unit increase in the body-mass index, converted to a z score, was associated with an increase in the risk of the metabolic syndrome among overweight and obese subjects (odds ratio, 1.55; 95 percent confidence interval, 1.16 to 2.08), as was each unit of increase in insulin resistance as assessed with the homeostatic model (odds ratio, 1.12; 95 percent confidence interval, 1.07 to 1.18 for each additional unit of insulin resistance). The prevalence of the metabolic syndrome increased significantly with increasing insulin resistance (P for trend, <0.001) after adjustment for race or ethnic group and the degree of obesity. C-reactive protein levels increased and adiponectin levels decreased with increasing obesity. The author has concluded that the prevalence of the metabolic syndrome is high among obese children and adolescents, and it increases with worsening obesity. Biomarkers of an increased risk of adverse cardiovascular outcomes are already present in these youngsters.<sup>49</sup>

16) **ALISON OKADA WOLLITZER** et al (2004) has concluded that Adolescent obesity has strong association with consumption of junk food and soda consumption

17) **Margaret C Mirch, Jennifer R McDuffie, Susan Z Yanovski** has stated that the ability to consume large quantities of palatable foods, coupled with decreased subsequent satiety, may play a role in the greater weight gain found in binge-eating children<sup>56</sup>

18) **Myles S. Faith** et al Genes that promote childhood obesity may partially exert their influence through eating in the absence of hunger an effect that was limited to boys born at risk for obesity<sup>58</sup>

19) **Carnethon MR, Gidding SS, Nehgme R, Sidney S, Jacobs DR Jr, Liu K.** in his article Cardiorespiratory fitness in young adulthood and the development of cardiovascular disease risk factors has said that regular exercise provides additional health benefits for overweight individuals, including prevention of future risk acquisition, improved insulin sensitivity, blood pressure reduction, and improved socialization through group participation in Activities<sup>60</sup>

20) **Jonatan R Ruiz, Nico S Rizzo, Anita Hurtig-Wennlöf, Francisco B Ortega, Julia Wärnberg and Michael Sjöström**



<sup>61</sup>Relations of total physical activity and intensity to fitness and fatness in have a greater effect on preventing obesity in children than does physical activity of lower intensity, whereas both moderate to vigorous Physical Activity may improve children's Cardiovascular functions.

21) **Arnold H. Slyper** diets restricted in sweetened sodas and noncitrus juices and containing ample whole grains, vegetables, and fruit could have a major impact on the prevalence of pediatric obesity<sup>62</sup>

22) **Kevin Patrick, MD, MS; Gregory J. Norman, PhD; Karen J. Calfas et al**In total of 878 adolescents aged 11 to 15 years 7 dietary and physical activity variables examined. Insufficient vigorous physical activity was the only risk factor for higher body mass index for adolescent boys and girls.

23) **Teresia M. O'Connor, MD, Su-Jau Yang, MS and Theresa A. Nicklas**, Increased beverage consumption was associated with an increase in the total energy intake of the children<sup>64</sup>

24) **R. P. Troiano, K. M. Flegal, R. J. Kuczmarski, S. M. Campbell and C. L. Johnson** From 1988 to 1991, the prevalence of overweight was 10.9% based on the 95th percentile and 22% based on

the 85th percentile. Attempts to increase physical activity may provide a means to address this important public health problem<sup>65</sup>.

25) **Calamaro, Christina J et al.** Television viewing habits, food portion sizes, parent-child feeding relations, and vending machine snack prices and availability may promote overweight in children to varying degrees.<sup>66</sup>

26) **Mehta M, Bhasin SK, Agrawal K, Dwivedi S.** The study comprised of 414 affluent schoolgirls of 16 and 17 yr age groups. Prevalence of obesity amongst the study subjects was 5.3% (i. e. 22 out of 414 were obese *i. e.* had BMI  $\geq$  30) and prevalence of overweight was 15.2% (i. e. 63 out of 414 were overweight *i. e.* had BMI equal to or more than 25 but less than 30). The prevalence of obesity was estimated to be 6.2% in the 16-yr-old girls (n = 210) and 4.4% in the 17-yr-old

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# Study Justification

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## **STUDY JUSTIFICATION**

Development of effective strategies to prevent adolescent obesity is hampered by the lack of understanding and lack of identification of which behavioral and environmental determinants need to be modified. The purpose of this study is to evaluate the relationship between these determinants and the onset of adolescent obesity.

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# Aim of the Study

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## **AIM OF THE STUDY**

- 1) To determine the prevalence of adolescent obesity
- 2) To determine the correlation between fat intake, vegetables, fruits and fibres intake and obesity in adolescents
- 2) To study the correlation between the behaviours related to eating and obesity in adolescents
- 3) To study the correlation between physical activity and obesity in adolescents
- 4) To determine the correlation between sedentary activities and adolescent obesity.

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# Methodology

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# METHODOLOGY

STUDY DESIGN:CASE CONTROL STUDY

STUDY PLACE:SCHOOLS IN CHENNAI

STUDY PERIOD: OCTOBER 2005 and NOVEMBER 2007

## **INCLUSION CRITERIA:**

Adolescents in the age group of 11-17 years with BMI greater than 95th percentile based on the Body mass index for age and sex percentile chart.

## **PROCEDURE**

### *Measuring weight*

- 1) Adolescents weighed using a platform scale.
- 2) Outer clothing and shoes removed
- 3) The scale is placed in the zero position before the child steps on the scale.
- 4) The child made to stand still with both feet in the centre of the platform.
- 5) Measurement recorded to the nearest 100grams



### *Measuring height*

A standing height board is used. This device has a flat vertical surface on which a measuring scale is attached. It also has a moveable headpiece and a permanent surface to stand.

- 1) Shoes or slippers removed
- 2) Child made to stand erect with shoulders at level, hands at sides, thighs together, and weight evenly distributed between both the feet.
- 3) Child's feet placed flat on the floor with heels comfortably together and touching the base of the vertical board.
- 4) Four contact points between the body and the stadiometer
- 5) Ask the child to adjust the angle of his/her head by moving the chin up or down in order to align the head in the Frankfurt plane(The Frankfurt plane-imaginary line from the lower margin of the eye socket to the notch above the tragus of the ear). The plane is viewed from the side and at the eye level of the child.
- 6) The child is made to breathe in and maintain his/her position

- 7) Lower the headpiece until it touches firmly over the crown of the head and at right angle to the measurement surface
- 8) Record height to the nearest 0.1cm



## MEASURES

### *BMI CALCULATION*

$$\text{BMI} = \text{weight (kg)} / \text{height (m)}^2$$

The child's BMI is plotted in the Body mass index for age and sex percentile chart developed by the Centers for Disease Control and Prevention 2000(CDC GROWTH CHART 2000). .

OBESE	BMI-for-age and sex>95th percentile
TENDENCY TO OBESE/ OVERWEIGHT	BMI-for-age and sex:85TH TO 95th percentile

Based on the above definitions children were classified as obese. Obese children are taken as cases and age and sex standardised non obese adolescents are taken as controls in the ratio of 1:1

A Questionnaire to assess the dietary pattern, behaviours related to eating, physical activity and TV viewing was distributed to both the cases and controls. children were given necessary help to complete the Questionnaire.

The Questionnaire contains 18 questions grouped into four broad categories namely

- 1) dietary pattern
- 2) behaviours related to eating,
- 3) physical activity and
- 4) sedentary lifestyle

**1) *Dietary pattern***

This includes two questions one regarding the adolescents' fat intake and the other regarding vegetables and fruits intake. The fat screener questionnaire is a modified form of the questionnaire published by The Block Dietary Data Systems and Berkeley Nutrition Services now known as NutritionQuest. ([www.nutritionquest.com](http://www.nutritionquest.com))

**2) *Behaviours related to eating***

The behaviours related to eating included in the study are seeking food in the absence of hunger, losing control over eating, to seek food in response to sadness, boredom and restlessness, to seek food as a reward, to sneak or hide food, inappropriate behaviors like purging, fasting or excessive exercise after bingeing, evening hyperphagia, night awakening and bingeing, visiting fast food restaurants often, to consume lunch or dinner in groups and to skip or delay breakfast.

**3) *Physical activity***

Physical activity studied under two groups:

- a) commuting activities
- b) leisure time activities

Further, physical activity studied under the nature of physical activity into mild, moderate and vigorous physical activity.

#### 4) *Sedentary lifestyle*

This includes questions regarding hours of television viewing, having television in bedroom, to seek food advertised in the television and to eat while watching television

The 18 factors mentioned in the questionnaire were given a code each. (V1 to V18)

V1— CONSUMPTION OF HIGH FAT FOODS WITH FAT MORE THAN 35%

V2— CONSUMPTION OF FOOD RICH IN VEGETABLES, FRUITS AND FIBRES LESS THAN 5 SERVINGS/DAY.

V3— TO SEEK FOOD IN THE ABSENCE OF HUNGER.

V4— DO NOT HAVE A SENSE OF CONTROL OVER EATING.

V5— TO SEEK FOOD IN RESPONSE TO SADNESS BOREDOM, AND RESTLESSNESS

V6— TO SEEK FOOD AS A REWARD.

- V7— TO SNEAK OR HIDE FOOD.
- V8— INAPPROPRIATE BEHAVIOURS LIKE PURGING,  
FASTING OR EXCESSIVE EXERCISES AFTER  
BINGING.
- V9— DO MODERATE/VIGOROUS PHYSICAL ACTIVITY  
LESS THAN 60MTS PER DAY FOR MOST OF THE  
DAYS IN A WEEK
- V10— TO EAT MORE THAN HALF OF THE DAILY FOOD  
AFTER EVENING
- V11— TO WAKE UP FREQUENTLY AT NIGHT AND EAT.
- V12— TO VISIT FAST FOODS RESTAURANTS VERY OFTEN  
(5 OR MORE TIMES/WEEK)
- V13— TO CONSUME LUNCH/DINNER IN GROUPS
- V14— TO SKIP OR DELAY BREAKFAST .
- V15— TO WATCH TV/VIDEO GAMES MORE THAN 2 HOURS  
PER DAY
- V16— TO HAVE TV IN THE BEDROOM

V17— TO EAT FOOD ITEMS AFTER SEEING IT IN TV  
ADVERTISEMENTS.

V18— TO EAT WHILE WATCHING TV

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# Result

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## RESULTS

*Table I: Age and Sex composition of the sample*

AGE	BOYS	% AGE	GIRLS	% AGE	TOTAL NO. OF STUDENTS	% AGE
11	690	50.58%	674	49.41%	1364	14.27%
12	660	49.25%	680	49.66%	1340	14.02%
13	710	51.22%	676	48.77%	1386	14.50%
14	680	49.66%	690	50.36%	1370	14.33%
15	685	50.36%	675	49.63%	1360	14.22%
16	695	50.7%	675	49.27%	1370	14.33%
17	690	50.36%	680	49.66%	1370	14.33%
TOTAL	4171	43.63%	4750	49.68%	9560	100%

Of the 9560 school going adolescents, 4171(43.63%) are boys and 4750(49.68%) are girls. Of the sample 14.27% were of 11years, 14.02% were of 12 years, 14.50% were of 13 years, 14.33% were of 14 years, 14.22% were of 15 years, 14.33% each from 16 and 17 years. (TABLE I)

Based on the socioeconomic status according to modified Kuppuswmi's scale(1962) 89.54% were from class II upper middle

socioeconomic status, 7. 32% from class-III lower middle socioeconomic status, 3. 14% from class IV upper lower socioeconomic status.

**TABLE II: Age and Sex composition of the Obese adolescents**

AGE	BOYS	%AGE	GIRLS	%AGE	OBESE	%AGE
11	25	3.6%	16	2.37%	41	3.00%
12	36	5.45%	16	2.35%	52	3.88%
13	26	3.66%	28	4.14%	54	3.89%
14	30	4.41%	36	5.21%	66	4.81%
15	46	6.71%	24	3.56%	70	5.14%
16	42	6.04%	34	5.03%	76	5.54%
17	36	5.21%	30	4.41%	66	4.81%
TOTAL	241	56.70%	184	43.29%	425	4.45%

A total of 425 adolescents(4. 45%) detected during this survey were Obese. Prevalence of obesity among Chennai adolescents in the age group of 11-17 years was 4. 45%. Based on age Obesity is more prevalent in the age group of 15(5. 14%) and 16 years. (5. 54%). Prevalence of obesity was more among boys than girls. (56. 70% vs 43. 29%). (TABLE II)

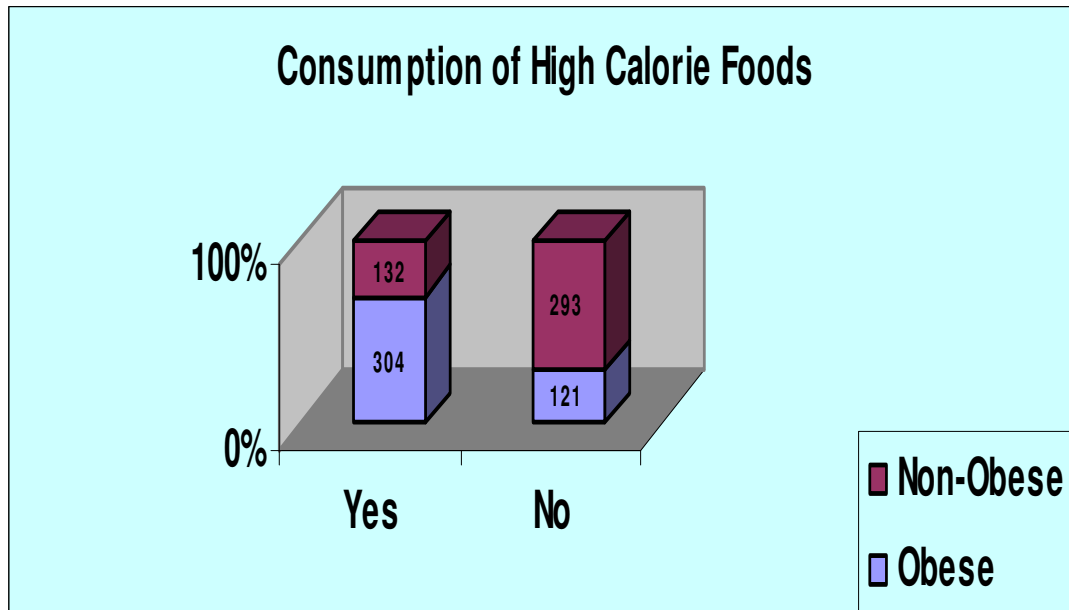
**Table III: Dietary Pattern –Univariate Model**

RISK FACTOR		CASE n (%)	CONTROL n (%)	ODDS RATIO	95% CI		P
					L	U	
VI	Y	304 (71.50%)	132 (31.10%)	5.577	4.155	7.485	0.0001
	N	121 (28.50%)	293 (68.90%)				
V2	Y	141 (33.20%)	297 (69.90%)	4.672	3.496	6.25	0.0001
	N	284 (66.80%)	128 (30.10%)				

**Table IV: Dietary Pattern –Multivariate Model**

RISK FACTOR	ODDS RATIO	95% CI		P Value
		LOWER	UPPER	
V1	5.7111	3.2594	10.0071	0.0001
V2	0.2558	0.1472	0.4444	0.5650

## CONSUMPTION OF HIGH FAT FOOD IN OBESE AND NON OBESE GROUP



304 (71.50%) adolescents consumed food with fat more than 35% when compared to 132 (31.10%) non obese adolescents. Obese adolescents consume fatty foods 5.7 times more than the non obese adolescents. Low intake of vegetables, fruits and fibres though emerged as a risk factor in univariate model failed to be statistically significant in multivariate model probably due to confounding factors

**TABLE V: Behaviors Related To Eating- Univariate Model**

RISK FACTOR		CASE n (%)	CONTROL n (%)	ODDS RATIO	95% CI		P
					L	U	
V3	Y	211 (49.60%)	240 (56.50%)	0.76	0.58	0.996	0.046
	N	214 (50.40%)	185 (43.50%)				
V4	Y	212 (49.90%)	210 (49.40%)	1.019	0.779	1.333	0.891
	N	213 (50.10%)	215 (50.60%)				
V5	Y	221 (52.00%)	211 (49.60%)	1.099	0.84	1.438	0.493
	N	204 (48.00%)	214 (50.40%)				
V6	Y	206 (48.50%)	198 (46.60%)	1.078	0.824	1.412	0.583
	N	219 (51.50%)	227 (53.40%)				

**TABLE V Behaviors Related To Eating- Univariate  
MODEL**

RISK FACTOR		CASE n (%)	CONTROL n (%)	ODDS RATIO	95% CI		P
					L	U	
V7	Y	218 (51.30%)	225 (52.90%)	0.936	0.715	1.225	0.631
	N	207 (48.70%)	200 (47.10%)				
V8	Y	215 (50.60%)	221 (52.00%)	0.945	0.722	1.237	0.681
	N	210 (49.40%)	204 (48.00%)				
V10	Y	313 (73.60%)	129 (30.40%)	6.413	4.756	8.646	0.0016
	N	112 (26.40%)	296 (69.60%)				
V11	Y	227 (53.40%)	198 (46.60%)	1.314	1.004	1.721	0.047
	N	198 (46.60%)	227 (53.40%)				

**TABLE V Behaviors Related To Eating- Univariate Model**

RISK FACTOR		CASE n (%)	CONTROL n (%)	ODDS RATIO	95% CI		P
					L	U	
V12	Y	306 (72.00%)	109 (25.60%)	7.455	5.502	10.1	0.0036
	N	119 (28.00%)	316 (74.40%)				
V13	Y	225 (52.90%)	222 (52.20%)	1.029	0.786	1.347	0.837
	N	200 (47.10%)	203 (47.80%)				
V14	Y	128 (30.10%)	274 (65.10%)	4.329	3.246	5.78	0.0027
	N	297 (69.90%)	147 (34.90%)				

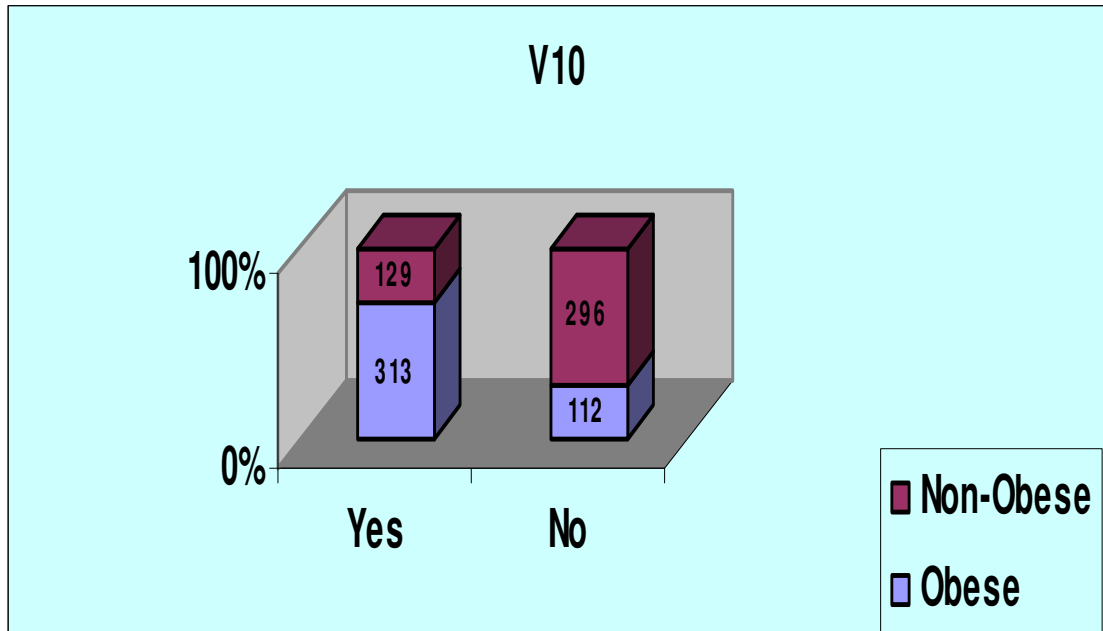
**TABLE VI Behaviors Related To Eating- Multivariate Model**

<b>RISK FACTOR</b>	<b>ODDS RATIO</b>	<b>95% CI</b>		<b>P VALUE</b>
		<b>LOWER</b>	<b>UPPER</b>	
V3	0.6153	0.3525	1.0739	0.0074
V4	0.9305	0.5400	1.6034	0.0095
V5	1.0815	0.6222	1.8800	0.7811
V6	0.6827	0.3940	1.1831	0.1736
V7	1.0780	0.6273	1.8524	0.0456
V8	0.9317	0.5440	1.5958	0.0376
V10	8.8101	4.9095	15.8098	0.0001
V11	1.3743	0.7921	2.3845	0.0007
V12	5.9797	3.3932	10.5378	0.0006
V13	2.0820	0.8978	3.6189	0.0533
V14	0.1577	0.0892	0.2790	0.0008

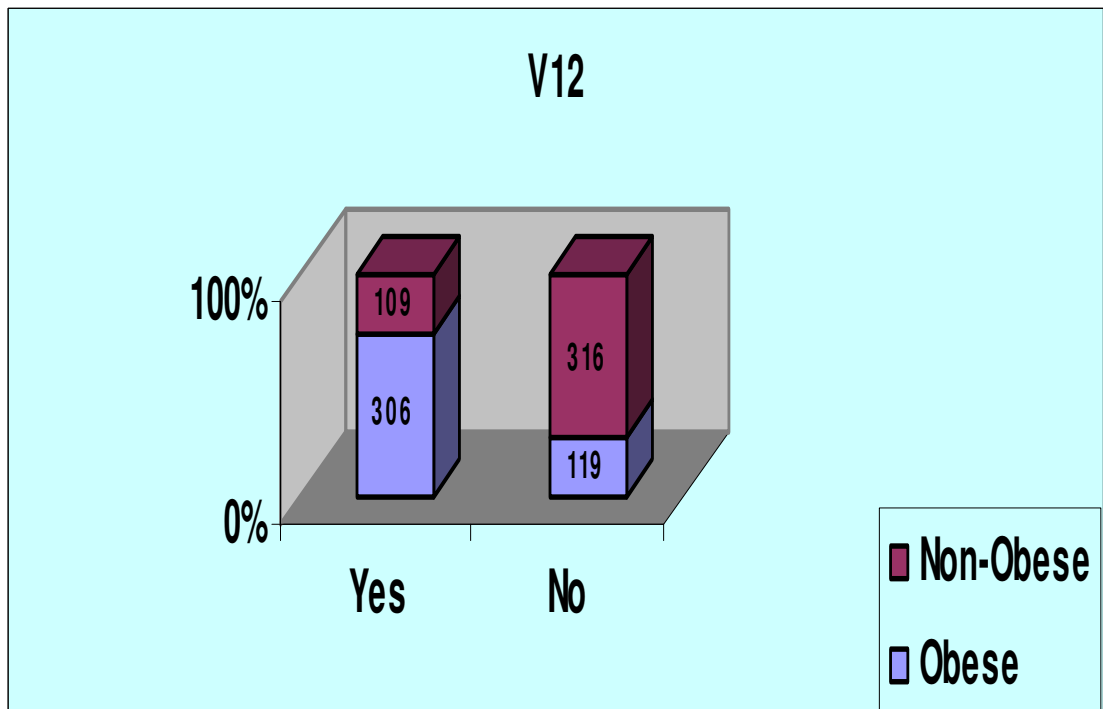


Among the 425 obese adolescents 313(73. 60%) persons ate more than half of the food after evening(evening hyperphagia) when compared to 129(30. 40%) persons in the non obese group. 306(72. 00%) obese adolescents visited fast food restaurants more than five times per week when compared to 109(25. 60%)non obese adolescents. 297(69. 90%) obese children had the behavior of skipping or delaying breakfast when compared to 274(65. 10%) in the control group. Based on multivariate logistic regression model, obese adolescents were 6. 4 times more likely to have evening hyperphagia and 7. 4 times more likely to visit fast food restaurants. skipping or delaying breakfast did not emerge as a risk factor in multivariate model due to the effect of confounding factors. The other risk factors(V3, V4, V5, V6, V7, V8, V11, V13) were not associated with the onset of adolescent obesity.

***EVENING HYPERPHAGIA IN OBESE AND NON OBESE GROUP(V10)***



***VISITING FAST FOOD RESTAURANTS MORE THAN 5 TIMES PER WEEK IN OBESE AND NON OBESE GROUP(V12)***



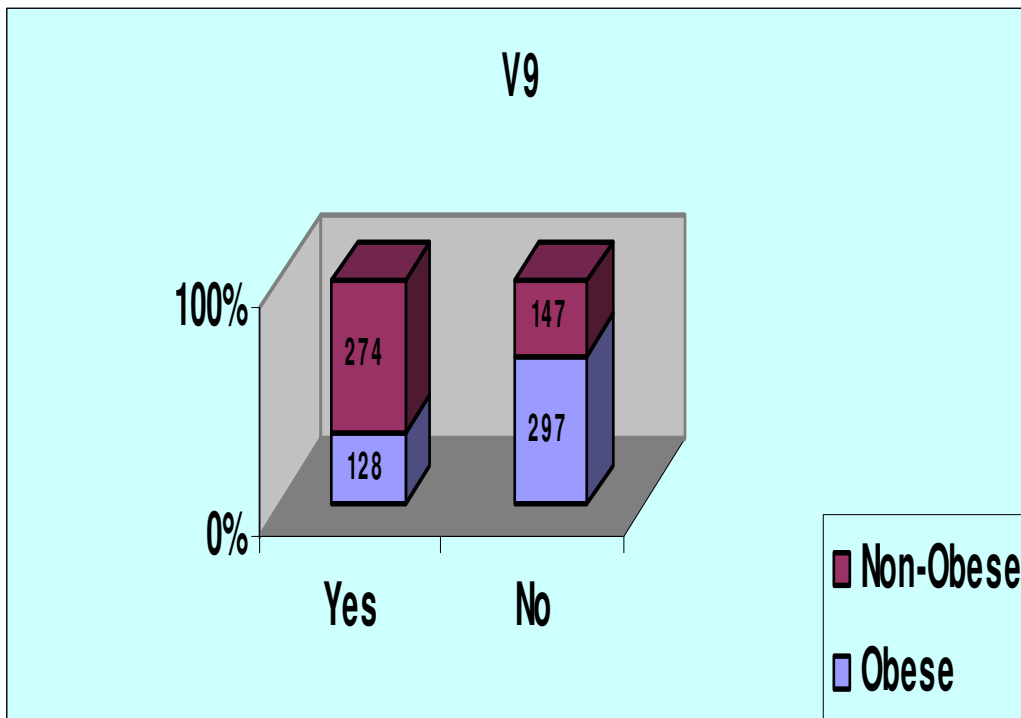
**TABLEVII :**      *Physical Activity- Univariate Model*

RISK FACTOR		CASE n (%)	CONTROL n (%)	ODDS RATIO	95% CI		P
					L	U	
V9	Y	302 (71.10%)	115 (27.10%)	6.619	4.905	8.93	0.0023
	N	123 (28.90%)	310 (72.90%)				

**Table VIII :**      *Physical Activity- Multivariate Model*

RISK FACTOR	ODDS RATIO	95% CI		P VALUE
		LOWER	UPPER	
V9	8.2381	4.7004	14.4386	0.0003

**LACK OF PHYSICAL ACTIVITY IN OBESE AND NON OBESE GROUP**



302 (71.10%) obese children did moderate or vigorous physical activity less than 30-60 minutes per day when compared to 115(27.10%) children in the non obese group. obese children were 8.2 times more likely to have this risk factor

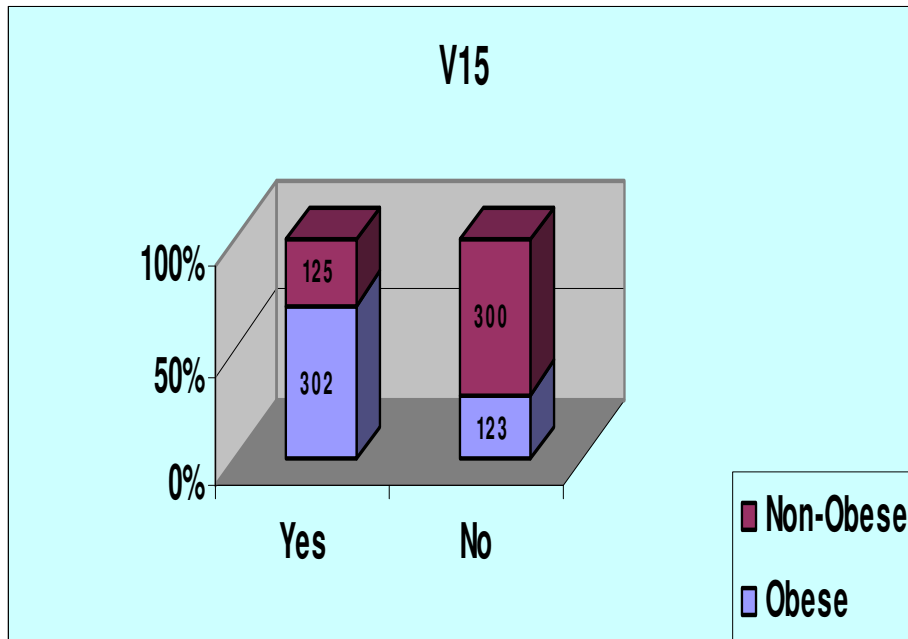
**Table IX: Sedentary Activity-Univariate Model**

RISK FACTOR		CASE n (%)	CONTROL n (%)	ODDS RATIO	95% CI		P
					L	U	
V15	Y	302 (71.10%)	125 (29.40%)	5.893	4.384	7.921	0.0045
	N	123 (28.90%)	300 (70.60%)				
V16	Y	308 (72.50%)	118 (27.80%)	6.849	5.071	9.251	0.0040
	N	117 (27.50%)	307 (72.20%)				
V17	Y	201 (47.30%)	211 (49.60%)	0.91	0.695	1.191	0.493
	N	224 (52.70%)	214 (50.40%)				
V18	Y	302 (71.10%)	118 (27.80%)	6.388	4.74	8.609	0.0056
	N	123 (28.90%)	307 (72.20%)				

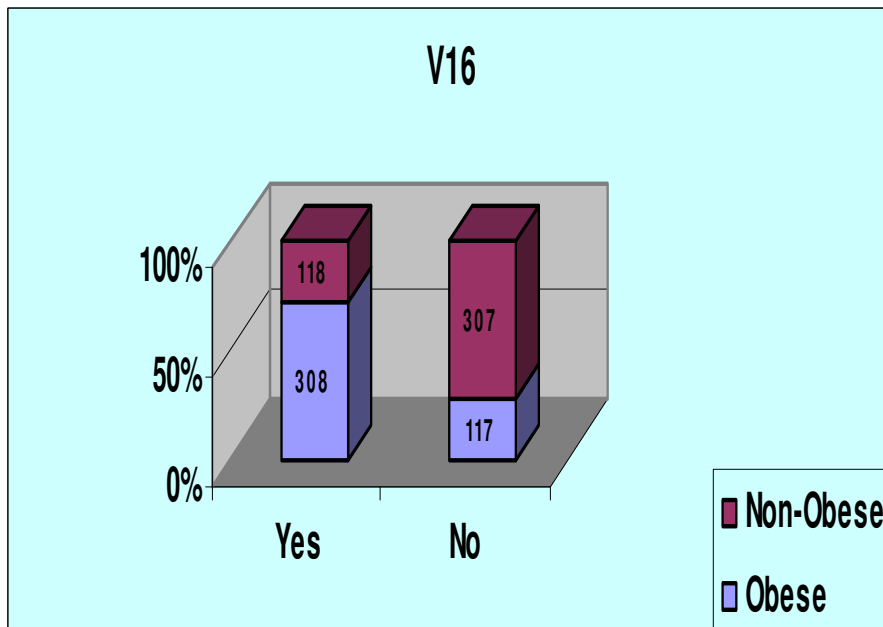
**Table X: Sedentary Activity- Multivariate Model**

	ODDS RATIO	95% CI		P VALUE
		LOWER	UPPER	
V15	5.8768	3.3605	10.2771	0.0003
V16	7.0038	3.9539	12.4064	0.0066
V17	0.9219	0.5340	1.59150	0.0222
V18	4.6560	2.6873	8.0669	0.0001

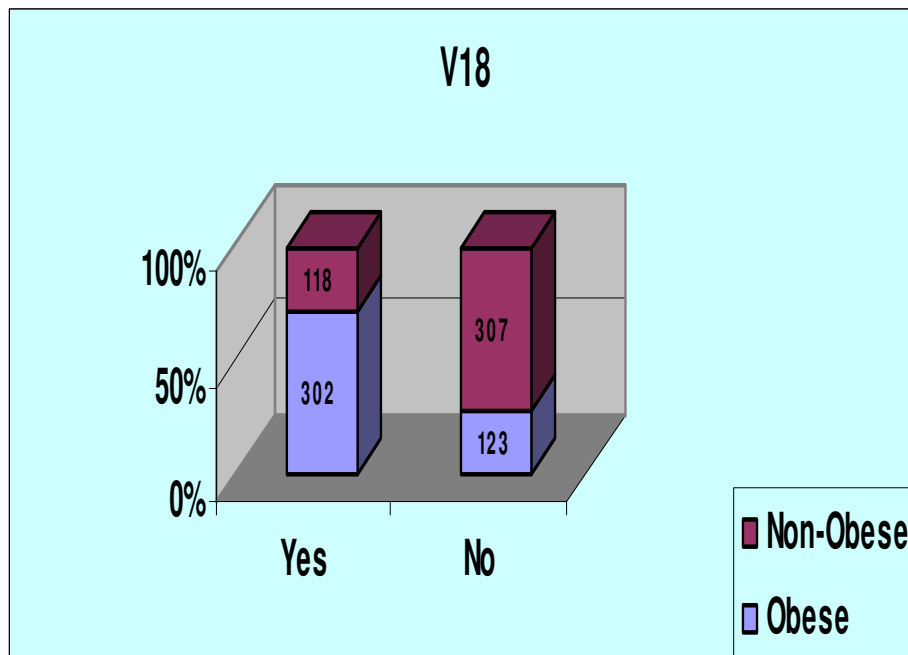
**WATCHING TV/VIDEO GAMES MORE THAN 2 HOURS PER DAY  
IN OBESE AND NON OBESE GROUP(V15)**



**TV IN BEDROOM IN OBESE AND NON OBESE(V16)**



## EATING WHILE WATCHING TV(V18)



302(71. 10%) obese adolescents watch Television/Video games more than 2 hours per day when compared to 125 (29. 40%) non obese adolescents. Television in bedroom was present in 308 (72. 50%) obese children when compared to 118 (27. 80%) non obese children. Eating while watching Television was present in 302 (71. 10%) obese children compared to 118(27. 80%) non obese children. Based on the above model obese adolescents were 5. 8 times more likely to watch Television more than 2 hours per day, 7 times more likely to have Television in the bedroom and 4. 6 times more likely to eat while watching Television.

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# Discussion

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## DISCUSSION

There is a difference of opinion about whether the percentage of dietary fat plays an important role in the rising prevalence of obesity and in its treatment once it has developed. Ample research from animal and clinical studies, from controlled trials, and from epidemiologic and ecologic analyses provides strong evidence that dietary fat plays a role in the development and treatment of obesity. A reduction in fat intake reduces the gap between total energy intake and total energy expenditure and thus is an effective strategy for reducing the present epidemic of obesity worldwide. A review of the results from 28 clinical trials that studied the effects of a reduction in the amount of energy from fat in the diet showed that a reduction of 10% in the proportion of energy from fat was associated with a reduction in weight of 16 g/d. We thus conclude that dietary fat plays a role in the development of obesity. To reduce the prevalence of obesity, there must be an increase in energy expenditure, a reduction in total energy intake, or both. This goal can be facilitated by reducing the amount of fat in the diet.

Obesity in children and adolescents represents one of the most frustrating and difficult diseases to treat. The Obesity Evaluation and

Treatment: Expert Committee Recommendations concludes that the total fat intake should provide 30–35 percent of total energy, saturated fatty acids plus trans fatty acids should provide no more than 12 percent of total energy, polyunsaturated fatty acids should provide approximately 8 percent of total energy and monounsaturated fatty acids should provide up to 20 percent of the total energy. Consumption of high-calorie, high-fat foods and high-calorie liquids are strongly associated with onset of childhood and adolescent obesity. Diet composition independent of total energy intake, resting energy expenditure and physical activity have been shown to be important in contributing to childhood and adolescent obesity. In diets of the same energy content, high fat diets promoted more weight gain than low-fat diets <sup>81</sup>

In the present study conducted in Chennai, high fat foods with fat more than 35% of the total calories shows a strong correlation with obesity among the adolescents. (OR : 5.7111 95% CI : 3.259-10.007). Similar conclusion were arrived by Jennifer A Batch and Louise A Baur et al in their article which states that the increased prevalence of obesity in recent decades may have resulted from an increased consumption of high fat foods<sup>67</sup>. Yoonna Lee et al compared the diet quality and weight status of girls. 192 girls were divided into 2 groups: >30% of energy from

fat (high fat [HF]) or  $\leq 30\%$  of energy from fat (low fat [LF]), based on girls' 3-day dietary recalls. The results of the study showed that Girls in the high fat [HF] group showed greater increase in body mass index and skinfold thickness from age 15 to 17 years.

Low intake of vegetables and fruits though emerged as a possible risk factor in univariate model (OR:4. 672 95% CI: 3. 496-6. 25) failed to be a significant risk factor in multivariate model (OR:0. 2558 95% CI : 0.147 - 0.444) probably due to the effect of confounding factors.

Regular exercise is essential in weight control. The current epidemic of overweight and obesity is largely caused by an environment that promotes excessive food intake and discourages Physical activity. The decrease in physical education in schools, changes in transportation methods and popularity of television, video games and the Internet all contribute to an increasingly sedentary lifestyles. Physical education, once an important part of every child's school day, has been cut back at many schools. Physical activity for better health and well-being has been an important theme throughout all times. Physical activity has numerous beneficial physiologic effects. Most widely appreciated are its effects on the cardiovascular and musculoskeletal systems, but benefits on the functioning of metabolic, endocrine, and immune systems are also

considerable. Overweight children are particularly at increased risk to have a low self - esteem and to suffer from stigmatization and discrimination. One report showed that the addition of regular Physical Activity lead to a higher self-esteem. It appears that the predominant effect of Physical Activity is not, as originally thought, in promoting substantial weight loss though increased calorie expenditure. Rather, it appears to be through metabolic changes that minimise the decline in resting metabolic rate, preserve lean body mass, reduce blood leptin levels and promote fat oxidisation, which favour the maintenance of the new lower body weight. Low levels of activity, resulting in fewer kilocalories used than consumed, contribute to the high prevalence of obesity. Physical activity may favorably affect body fat distribution. Ian Janssen et al<sup>49</sup> has concluded that physical inactivity and sedentary behaviors are strongly related to obesity in Canadian adolescents. In the present study reduced physical activity(moderate/vigorous) less than 30-60 minutes per day for most of the days in a week was strongly associated with the onset of obesity in adolescents. (OR:8. 2381 95% CI : 4.7004-14.4386).

C S Berkey<sup>80</sup> in his Longitudinal study of skipping breakfast and Fast food consumption and weight change in adolescents has stated that

skipping breakfast and Fast food consumption increased during the transition to adulthood, and both dietary behaviors are associated with increased weight gain from adolescence to adulthood.

In our present study Skipping or delaying breakfast showed a positive correlation with onset of obesity in adolescents in univariate analysis. (OR:4.329 95%CI:3.246-5.78) But in multiple logistic regression model it failed to emerge as a risk factor due to the effect of other confounding factors. (OR:0.1577 95%CI:0.0892-0.2790). But adolescents who ate more than half of their daily food after evening emerged as a risk factor to become obese. (OR:8.8101 95%CI:4.909-15.809)

Fast-food consumption may contribute to the growing level of obesity, through energy-dense foods, high fat content and large portion sizes. Fast food is known to be high in energy density, and fast-food outlets have an average menu of more than twice the energy density of recommended healthy diets. Shanthy A. Bowman et al<sup>81</sup> in her study on Effects of Fast-Food Consumption on Energy Intake and Diet Quality has concluded that Children who ate fast food, compared with those who did not, consumed more total energy (187 kcal; 95% confidence interval [CI]: 109–265), more energy per gram of food (0.29 kcal/g; 95% CI: 0.25–0.33), more total fat (9 g; 95% CI: 5.0–13.0) and Consumption of fast

food among children in the United States seems to have an adverse effect on dietary quality in ways that plausibly could increase risk for obesity. In our present study Eating in Fast food restaurants five or more times per week emerged as a key risk factor in both univariate and multiple logistic regression model(OR:5. 9797 95% CI:3. 3932-10. 5378).

Television viewing is a major activity and influence on children and adolescents. While television can entertain, inform, and keep our children company, it may also influence them in undesirable ways. Television viewing could contribute to obesity because of changes in both sides of the energy homeostatic equation: decreased energy expenditure and increased energy intake. Television viewing may “displace” exercise from one's daily routine, thereby reducing energy expenditure and it may lower the metabolic rate more than other sedentary activities. Television viewing may also lead to increased caloric intake because of less mindful eating while watching television or exposure to advertising of high-calorie foods. Alternatively, obesity could lead to decreased mobility or poor health, which in turn could lead to increased television viewing

Both epidemiologic and experimental evidence from the past decade indicates that television viewing is an important determinant of adolescent obesity. Multiple cross-sectional and longitudinal

observational studies document the impact of television,<sup>(68-72)</sup> on overweight in adolescents. These observational studies have been corroborated by randomized controlled trials designed to reduce levels of television viewing<sup>[73-76]</sup> and to reduce obesity. On average, children aged 11–17 spend 4.5 hours a day watching some kind of screen with 2.7 hours of that spent watching television. . In the present study too, Sedentary activity in the form of watching TV/Video games more than 2 hours per day emerged as one of the key risk factors for obesity in adolescents. Both in univariate (OR: 5.893 95% CI:4. 384-7.921) and multivariate logistic regression models(OR:5. 8768 95% CI : 3.3605-10. 2771) it emerged as a significant risk factor. Luis F Gomez<sup>77</sup> et al in the study on Television viewing and its association with obesity, children classified as excessive TV viewers (2 to 3. 9 hours/day or 4 or more hours/day) were more likely to be obesity (OR: 1. 44 95% CI: 1.41–1.47 and OR: 1. 32 95% CI: 1. 30–1. 34, respectively) than those who watched less than 2 hours/day. In another study of adolescents (ages 11-14), a child's risk of being obesity increased by 6% for every hour of television watched per day. If that child had a TV in his or her bedroom, the odds of being obesity jumped an additional 31% for every hour watched. (Dennison, et al. , 2002).

Most experts agree that eating while watching TV encourages mindless eating. Eating while viewing television could contribute to obesity by causing patients to overeat, even if they were not hungry, or to lose track of portion sizes while their minds were occupied by a television program or video. In addition, viewing of advertisements for high-calorie foods might account for some of the observed association<sup>78</sup> In our present study eating while watching TV emerged as a risk factor for obesity in adolescents. ( OR:4. 6560 95%CI:2. 6873-8. 0669)

Christelle Delmas<sup>79</sup> et al in his study to determine if having a television (TV) in the bedroom is associated with increased adiposity throughout adolescence has concluded that TV in bedroom is associated with higher BMI, higher waist circumference and body fat. Similar results were obtained in the present study too where TV in bedroom showed a strong positive correlation with the onset of obesity in adolescents. (OR:7.0038 95% CI : 3.9539 - 12.4064S). These results suggest the importance of keeping TV out of an adolescent's bedroom from an obesity prevention perspective.



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# Conclusion

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## CONCLUSION

- Prevalence of obesity in adolescents in the age group of 11 to 17 in Chennai is 4.45%
- Prevalence of obesity is more in the age group of 15-16 years
- Prevalence of obesity is more in boys than girls
- Dietary pattern:  
  
High intake of fatty foods with fat more than 35% of the total caloric intake is a risk factor for adolescent obesity
- Behaviors related to eating:  
  
Evening hyperphagia and Eating in fast food restaurants very often are associated with the onset of adolescent obesity
- Physical activity:  
  
Moderate or vigorous physical activities less than 30-60 minutes per day for most of the days in a week is associated with onset of adolescent obesity.

➤ Sedentary lifestyle:

Watching television more than 2 hours per day, To have Television in the bedroom and to eat while watching Television are strongly associated with onset of adolescent obesity.

## **RECOMMENDATIONS**

*Interventions suggested to prevent the onset of obesity in adolescents based on this study:*

- Balanced eating plan—to eat meals with less than 35% of the total calories derived from fat, to reduce the intake of corn chips, potato chips, cake, cookies, fried potatoes, icecream, pizza, softdrinks, tined foods, friedchicken and mutton. To avoid using vanaspathi or butter in cooking. To increase vegetables (beans, peas, corn, greenleaves) and fruits.
- Behavioral approach to treat evening hyperphagia
- To reduce visiting fast food restaurants often
- To build up slowly 30 minutes of moderate physical activity in day. the 30 minutes can be accumulated throughout the day in 10 to

15 minutes bouts. Increase the amount of daily routine activities such as gardening, shopping, housework, walking, etc.

- To reduce TV viewing less than 2 hours per day, to avoid eating while watching TV and to avoid having TV in bedroom.

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# Annexure

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## ANNEXURE

*Questionnaire to assess the dietary pattern, behaviours related to eating, physical activity and TV viewing among the adolescents (11-17 years) in Chennai*

S.NO :

NAME :

AGE :

SEX :        MALE  
              FEMALE

ADDRESS:

Height :

Weight :

BMI :

PERCENTILE:

>95<sup>TH</sup> PERCENTILE

85-95<sup>TH</sup> PERCENTILE

<85<sup>TH</sup> PERCENTILE

CASE

CONTROL

**(1) Questions Regarding Dietary Fat Intake**

Think about your eating habits over the past year or so. About how often do you eat each of the following foods? Remember breakfast, lunch, dinner and snacks. Tick the appropriate box for each food.

<i>Meats and Snacks</i>	<i>1/MONTH or less</i>	<i>2-3 times a MONTH</i>	<i>1-2 times a WEEK</i>	<i>3-4 times a WEEK</i>	<i>5+ times a WEEK</i>
Fried chicken					
Beef or pork, such as steaks, roasts, or in sandwiches					
butter on bread or potatoes					
vanaspathi, butter or oil in cooking					
Eggs					
Pizza, soft drinks, tinned foods					
Cheese, cheese spread					
Whole milk					
French fries, fried potatoes					
Corn chips, potato chips, popcorn, crackers					
Doughnuts, pastries, cake, cookies					
Ice cream					

**PERCENTAGE OF FAT INTAKE PER DAY:**

DO YOU CONSUME HIGH CALORIE FOODS: YES/ NO  
(MORE THAN 35%)

**(2) Questions Regarding Fruit, Vegetables And Fibre Intake**

<i>Fruits, Vegetables, and Grains</i>	<i>2-3 times a WEEK</i>	<i>4-6 times a WEEK</i>	<i>Once a DAY</i>	<i>2-3 times a day</i>	<i>4-5 times a day</i>	<i>&gt;5 times a day</i>
Fruit juice, like orange, apple, grape, fresh, frozen or canned. (Not sodas or other drinks)						
How often do you eat any fruit, fresh or canned (not counting juice?)						
Vegetable juice, like tomato juice, carrot juice						
Green leaves						
Potatoes, any kind, including baked, mashed						
Vegetable soup, or stew with vegetables						
Any other vegetables, including string beans, peas, corn, or any other kind						
Beans such as baked beans, kidney, or lentils (not green beans)						

- (2) DO YOU CONSUME FOOD RICH IN VEGETABLES, FRUITS AND FIBRES ATLEAST 5 SERVINGS/DAY)? YES / NO
- (3) DO YOU SEEK FOOD IN THE ABSENCE OF HUNGER? YES/NO
- (4) DO YOU HAVE A SENSE OF CONTROL OVER EATING? YES/NO
- (5) DO YOU SEEK FOOD IN RESPONSE TO SADNESS, BOREDOM, AND RESTLESSNESS? YES/NO
- (6) DO YOU SEEK FOOD AS A REWARD? YES/NO
- (7) DO YOU SNEAK OR HIDE FOOD? YES/NO
- (8) DO YOU AFTER BINGING USE INAPPROPRIATE BEHAVIOURS LIKE PURGING, FASTING OR EXCESSIVE EXERCISES? YES/ NO
- (9) DO YOU SKIP OR DELAY BREAKFAST? YES/ NO
- (10) DO YOU EATS MORE THAN HALF OF THE DAILY FOOD AFTER EVENING (5.00PM)? YES/ NO
- (11) DO YOU WAKE UP FREQUENTLY AT NIGHT (AFTER 11.00PM AND BEFORE 5.00AM) AND EAT? YES/ NO
- (12) DO YOU VISIT FAST FOODS RESTAURANTS VERY OFTEN (5 OR MORE TIMES/WEEK) YES/ NO



(13) DO YOU CONSUME LUNCH/DINNER IN GROUPS? (GROUP MUST HAVE ATLEST NINE CHILDREN) YES/ NO

(14) PHYSICAL ACTIVITY

<p>MILD PHYSICAL ACTIVITY</p>	<p>Walking slowly stationary Cycling slow treading Swimming light stretching Home care- carpet sweeping</p>
<p>MODERATE PHYSICAL ACTIVITY</p>	<p>Walking, briskly Cycling for pleasure or transportation Swimming, moderate effort Moderate stretching Racket sports, table tennis Home care, general cleaning</p>
<p>VIGOROUS/HARD PHYSICAL ACTIVITY</p>	<p>Walking briskly uphill, or with load Cycling fast or racing Swimming fast Vigorous stretching Vigorous athletic activities Home care, Moving furniture</p>

Commuting Activities	Days / Week	Average time / Day	Effort
Walking from / to school	Days	Hrs    Min	light / Moderate /hard
Bicycling from / to school	Days	Hrs    Min	Light/Moderate / hard

Leisure Time Activities	Days / Week	Average time / Day	Effort
Walking	Days	Hrs    Min	Light / Moderate / hard
Bicycling	Days	Hrs    Min	Light / Moderate /hard

(14) DO YOU DO MODERATE/VIGOROUS PHYSICAL ACTIVITY FOR ATLEAST 30-60MTS PER DAY FOR MOST OF THE DAYS IN A WEEK YES / NO

**TELEVISION/VIDEO GAMES VIEWING**

(15) DO YOU WATCH TV/VIDEO GAMES MORE THAN 2 HOURS PER DAY? YES / NO

(16) DO YOU HAVE TV IN THE BEDROOM? YES /NO

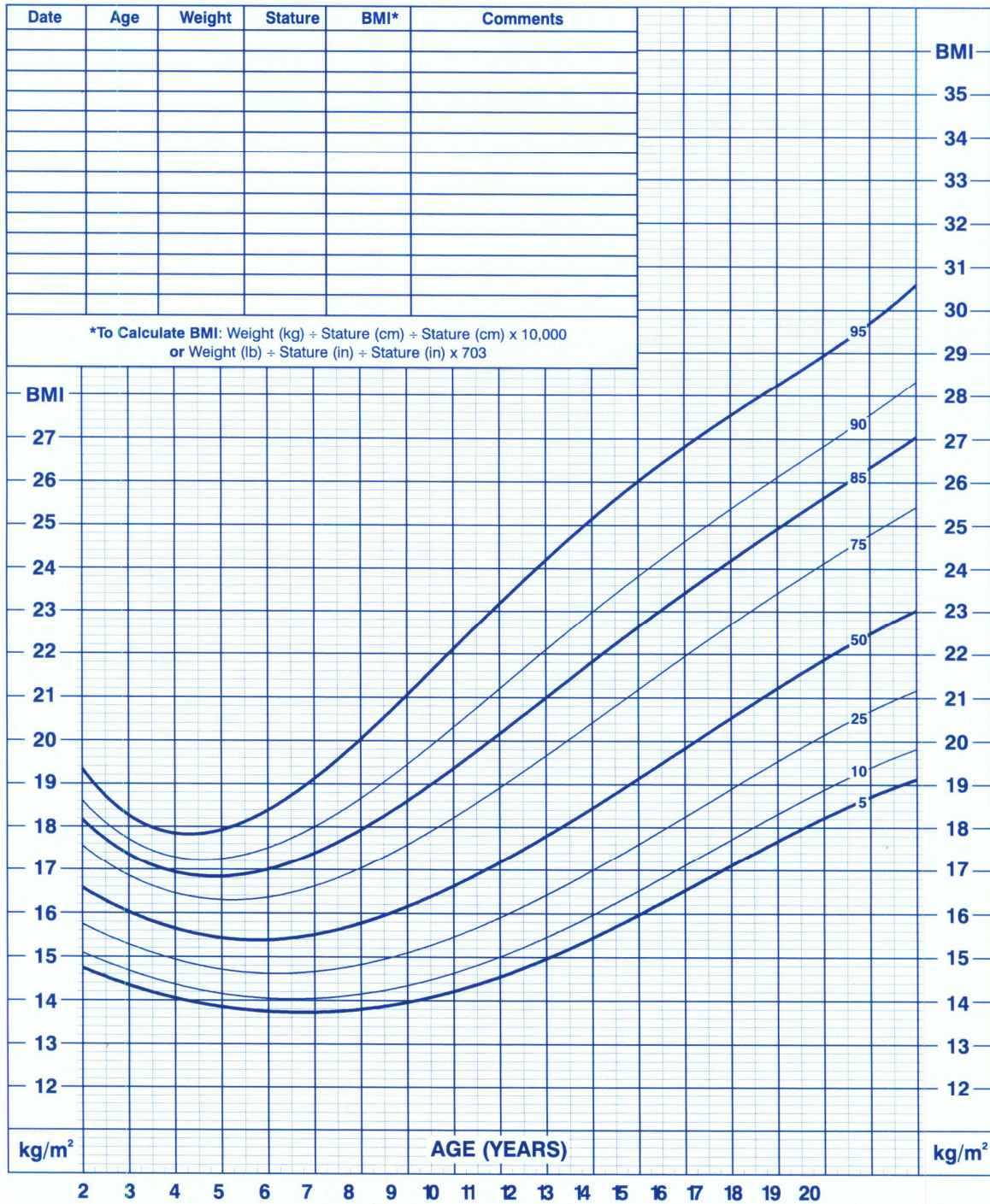
(17) DO YOU EAT FOOD ITEMS AFTER SEEING IT IN TV ADVERTISEMENTS? YES /NO

(18) DO YOU HAVE THE HABIT OF EATING WHILE WATCHING TV? YES / NO

**2 to 20 years: Boys**  
**Body mass index-for-age percentiles**

NAME \_\_\_\_\_

RECORD # \_\_\_\_\_



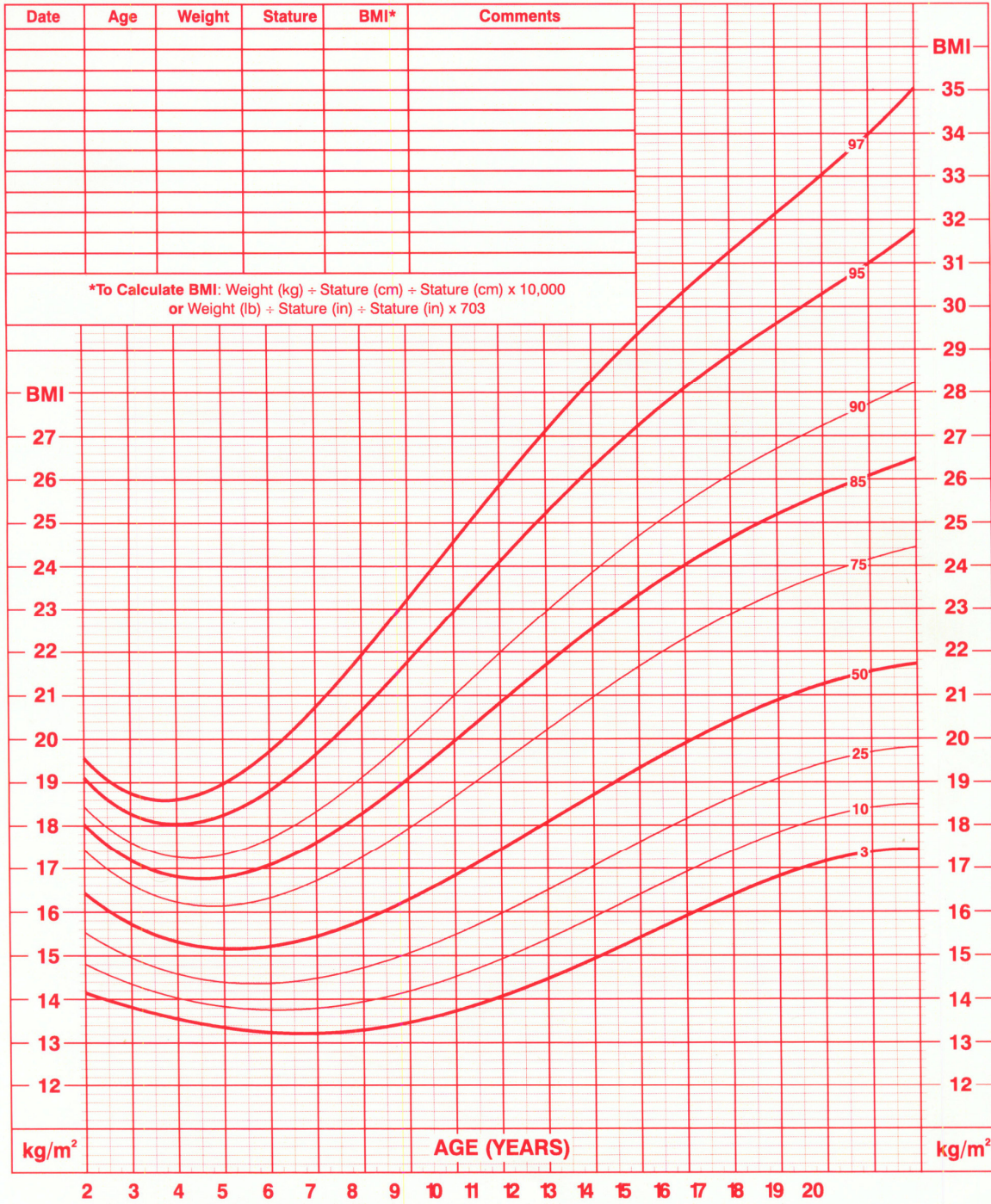
Published May 30, 2000 (modified 10/16/00).  
SOURCE: Developed by the National Center for Health Statistics in collaboration with  
the National Center for Chronic Disease Prevention and Health Promotion (2000).  
<http://www.cdc.gov/growthcharts>



**2 to 20 years: Girls**  
**Body mass index-for-age percentiles**

NAME \_\_\_\_\_

RECORD # \_\_\_\_\_



Published May 30, 2000 (modified 10/16/00).  
 SOURCE: Developed by the National Center for Health Statistics in collaboration with  
 the National Center for Chronic Disease Prevention and Health Promotion (2000).  
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