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PREVALENCE OF OVERWEIGHT AND OBESITY AMONG SCHOOL AND COLLEGE GOING ADOLESCENTS IN RURAL AND URBAN THIRUVANANTHAPURAM DISTRICTS, KERALA, INDIA

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INTRODUCTION

For the first time in human history, the number of overweight rivals the number of underweight, according to a report from the Worldwatch Institute, a Washington, DC-based research organization. In 1999, the world's underfed population was 1.1 billion showing a decline since 1980, while the number of overweight people was 1.1 billion showing an increase[1]. At the other end of the malnutrition scale, obesity is one of today's most blatantly visible – yet most neglected – public health problems[2]. Malnutrition, as understood now, encompasses a whole spectrum of nutritional disorders including overweight and obesity. The public health impact is enormous: more than half of the world's disease burden-measured in "years of healthy life lost"-is attributable to hunger, overeating, and widespread vitamin and mineral deficiencies[1]. Paradoxically coexisting with under nutrition, an escalating global epidemic of overweight and obesity - *globesity* – is taking over many parts of the world[2].If immediate action is not taken, millions will suffer from an array of serious health disorders[1].

Overweight and obesity

Obesity is a complex condition with serious social and psychological dimensions, that affects virtually all age and socioeconomic groups and threatens to overwhelm both developed and developing countries. The hungry and the overweight share high levels of sickness and disability, shortened life expectancies, and lower levels of productivity-each of which is a drag on a country's development[1]. In 1995, there were an estimated 200 million obese adults worldwide and another 18 million under-five children classified as overweight. As of 2000, the number of obese adults has increased to over 300 million[2]. Contrary to conventional wisdom, the obesity epidemic is not restricted to industrialized societies; in developing countries, it is estimated that over 115 million people suffer from obesity-related problems[2]. The data of Wright et al show that body mass index in childhood and at age 50 are strongly associated for example, among children in the top quarter of weight at 9 years, 73.0% (59/81) become overweight or obese adults at age 50, whereas of those who are in the top

quarter at 13, 8% (64/78) are overweight or obese at age 50. This emphasizes that overweight or obese children tend to be overweight or obese adults too and it is not true that thin children are just as likely to be fat adults[3].

Generally, although men have higher rates of overweight, women have higher rates of obesity[2]. For both, obesity poses a major risk for serious diet-related non-communicable diseases, including diabetes mellitus, cardiovascular disease, hypertension and stroke, and certain forms of cancer. Its health consequences range from increased risk of premature death to serious chronic conditions that reduce the overall quality of life[4].

Obesity in the developing world can be seen as a result of a series of changes in diet, physical activity, health and nutrition, collectively known as the 'nutrition transition.' As poor countries become more prosperous, they acquire some of the benefits along with some of the problems of industrialized nations. These include obesity[5].

Since urban areas are much further along in the transition than rural ones, they experience higher rates of obesity. Cities offer a greater range of food choices, generally at lower prices. Urban work often demands less physical exertion than rural work. And as more and more women work away from home, they may be too busy to shop for, prepare and cook healthy meals at home. The fact that more people are moving to the city compounds the problem. In 1900, just 10% of the world population inhabited cities; today, it is 50%[5].

Overweight and obesity in India

There is increasing evidence that children and adolescents of affluent families are overweight. It is possibly because of decreased physical activity, sedentary lifestyle, altered eating patterns with more fat content in the diet as found in some studies[6].Only 19% of school children were found to be engaged in outdoor activities while 90% of the obese children did not engage in any outdoor activity at all[6]. Several other studies in India[7] have shown that changes in dietary patterns, physical activity levels, life styles associated with affluence, and migration to urban areas are related to increasing frequencies of obesity and the risk of diseases, such as coronary heart disease and diabetes[8]. Four per cent of males and 14% of females above 40 years in India are obese.

The problem of obesity was found to be more prevalent in the upper-middle class than among slum dwellers according to a study in Delhi by the Nutrition Foundation of India. As against the prevalence rate of obesity of 1% for males and 4% for females in the slums, the corresponding figures for the high-income group among the middle class were 32.2% and

50% respectively. Apart from dietary errors and excesses, the lack of regular physical exercise among urban middle class persons with sedentary occupations is a major contributor to overweight and obesity[8].

Obesity in adolescents

During 1963-80, the prevalence of childhood obesity increased by 54% among 6-11 year old and 39% among adolescents (12-17 years); severe obesity increased by 98% and 64% respectively. In 1999, 13% of children aged 6-11 years and 14% of adolescents aged 12-19 years in the US were overweight; the prevalence has nearly tripled for adolescents in the past 2 decades. 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. Type-2 diabetes, previously considered an adult disease, has increased considerably in children and adolescents. Overweight and obesity are closely linked to type-2 diabetes.

Overweight 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. Overweight in adolescents may have deleterious effects on their subsequent self-esteem, social and economic characteristics, and physical health[9].

Causes and trends

Overweight in children/adolescents is caused by lack of physical activity, unhealthy eating patterns, or a combination of both with genetics and lifestyle playing important roles in determining a child's weight. Television, computer and video games contribute to children's inactive lifestyles; 43% of adolescents watch TV for 2 hours/day. Children, especially girls, become less active as they move through adolescence[9]. Food preferences developed in childhood remain fairly constant into adulthood. In a society that boasts "super size" meals, all-you-can-eat buffets and spends millions of dollars advertising to youngsters, it can be quite a challenge for a child to develop good eating habits. Children are eating more meals away from home and those meals are often high in fat and low in fiber-rich carbohydrates such as fruits, vegetables and whole grains. It is easy for children to consume high fat, calorie-dense foods because many kids are provided with pocket money and have the freedom of choice in meals, especially breakfast and lunch[10]. Another trend that is important to mention

is the shift from drinking milk to more non-citrus juices, juice drinks and other calorie-dense beverages. Excessive juice consumption can lead to tooth decay and, in studies where children consumed more than 12 ounces a day, it was found to be associated with increased obesity and reduced height in 2-5 year old children. Large number of overweight children entering adulthood together with weight gain in adulthood portends an enormous burden - human suffering, lost productivity, and health care expenditures[10].

Burden of obesity

Cost of obesity-related diseases accounts for 2-8% of the total health care expenditure[4]. A recent study shows a significant increase in costs with increasing BMI, from Euro 81/month for subject with 25<BMI <30, to Euro 112.5/month for subjects with 30 < BMI<40, to Euro 162/month for individuals with BMI>40 (P<0.0001, Kruskall Wallis test). The most important item of cost was hospital care (64% of total costs), followed by drugs (7%), diagnostics, laboratory exams and physicians' visits (6% each), indicating that the major component of the cost of obesity and overweight is not prevention and treatment, but the care for complications[11].

Health consequences

It is now generally accepted that overweight and obesity increases the risk of chronic diseases, particularly cardiovascular disease, cancer and diabetes. The National Institute of Public Health in Stockholm estimates that 4% of DALYs lost in the European Union are due to overweight and obesity. Cardiovascular diseases and cancer, together with diabetes, account for about 30% of the total DALYs lost every year in WHO's European Region. Preliminary analysis from the Institute of Public Health in Sweden suggests that 4.5% of DALYs are lost in EU countries due to poor nutrition, with an additional 3.7% and 1.4% due to obesity and physical inactivity. The total percentage of DALYs lost related to poor nutrition and physical inactivity is therefore 9.6%, compared with 9% due to smoking. It is relatively rare (unfortunately) for physicians to treat obesity itself because it is a difficult long-term process to treat effectively. However, treatment for the complications is done at enormous cost. These confer increased morbidity and mortality on persons who are obese. Obesity is also directly responsible for loss in quality of life through a reduced capacity to perform a range of common daily activities, and through social and psychological effects.

Obesity is a serious illness that can lead to many medical complications. It is relatively rare (unfortunately) for physicians to treat obesity itself because it is a difficult long-term process to treat effectively. However, treatment for complications is done at enormous cost;

complications include hypertension, diabetes, cancer, heart attacks, strokes, degenerative arthritis, hypercholestremia, gallstones, sleep disorders and depression.

Rationale of the study

Though India is a country still combating the communicable diseases, Kerala on the other hand has an admirable health status comparable to the West and is now going through an epidemiological transition where non-communicable diseases are more prevalent. The 'nutritional transition' and the lifestyle changes are also becoming relevant among the adolescents. The popularity of 'fast foods', food from outside, fizzy drinks, sedentary lifestyles, increased 'pocket money', lack of sports, increased TV and computer watching and working parents have all led to a chance in the way of life, the effects of which have to be studied. There is paucity of data on prevalence of overweight and obesity in Kerala, especially so about the magnitude of the problem among the adolescents.

Objective

To estimate the prevalence of overweight and obesity among school and college going adolescents of 13-19 years of age in rural and urban Thiruvananthapuram district of Kerala, India.

Specific objectives

- To find the prevalence of obesity among adolescents in school/college going population of rural and urban Thiruvananthapuram
- To explore the dietary behaviour of these adolescents and
- To find if overweight/obesity is related to sex, socioeconomic status, religion, hours of TV viewing, physical activity, etc.

STUDIES ON OBESITY

Prevalence

Overweight prevalence varied from 7.4% to 10.4% with two peaks at 11.5 and 12.5 years of age in 1981 whereas it was 8.0-10.8% with three peaks at 10, 12.5 and 13.0 years in 1998.[7] Similar results were obtained by other studies to indicate a prevalence range of 7.4-10.9%.[6,8] Increasing trend of obesity is also observed in other countries.[13-15] Persistence of pediatric obesity into adulthood increases according to the age at which obesity is initially present.[16] The trend of increasing obesity in children may be the result of environmental and cultural changes related to physical inactivity in our society.[17] Factors such as increases in the availability and marketing of foods, increases in the use of computers and television viewing, greater reliance on motor vehicles for transport, reductions in physical education in schools and physical activity at work, and changes in family life related to increasing affluence have all been identified as potentially important as drivers of the obesity epidemic.[18-19] Relevance of sex in the prevalence, however, is not clear.[8,19] Adolescence is a time when independence is established and dietary and activity patterns may be adopted that is followed for many years[20].

Obesity is more prevalent in urban populations, particularly in the richer socio-economic groups.[21] In Tonga the prevalence of hypertension in males and of high systolic blood pressure, which may be influenced by dietary habits, in both sexes was greater in the urban than in the rural population.[22] Studies indicated that urban diets provide a more adequate energy and nutrient supply overall than rural diets in Costa Rica[23] and Tunisia.[24]

Family history

The risk of adult obesity was greater at any age in both obese and non obese children if at least one parent was obese. This effect was most pronounced in children aged <10 y. As each child aged, the effect of parental obesity was outweighed by the child's own obesity status[25]. It is also well established that obesity runs in families. The familial aggregation cannot be fully accounted for by shared environmental conditions and is more consistent with the notion that affected relatives share specific genetic characteristics[26]. The study also related obesity with nuclear families stating that 65 per cent of the children in the study were from nuclear families[6]. Studies of families and twins have clearly demonstrated a strong genetic component in the etiology of obesity[26,27,28].

Diet

Major dietary patterns are predictors of plasma biomarkers of CVD and obesity risk, suggesting that the effect of overall diet on CVD risk may be mediated through these biomarkers[29]. Dietary variety of sweets, snacks, condiments, entrées, and carbohydrates (as a group) is positively associated with body fatness whereas variety from vegetables is negatively associated.[30-31] A high variety of sweets, snacks, condiments, entrées, and carbohydrates coupled with a low variety of vegetables promotes long-term increases in energy intake and body fatness. Sedentary behaviour is higher in overweight children in the intervention group[32]. Some studies presented that soft drink consumption by children is not linked to pediatric obesity, poor diet quality, or a lack of exercise[32].

Kahle[33] et al showed that by restricting the diet and increasing the physical activity in the home environment itself was sufficient to stop weight gain and normalize key metabolic indices for prediction of atherosclerosis, hypertension, and diabetes. Brief interventions can improve the CVD risk profile of children with multiple risk factors. The classroom-based approach is easier to implement and uses fewer resources. Population approach is one means of early primary prevention of CVD.[34] Diet, behavior modification, and exercise help regain their initial weight.[35-36] Family involvement may reduce the progression of obesity in children, but the impact of this approach on adults is not clear[37].

Strategies aiming at reduction of sedentary behaviour and at an increase of physical activity may be fruitful in preventing obesity in children.[12,38-39] They are also unaware of their nutritional needs and so, adolescent education programmes may help.[6,40] Increasing overweight among youths implies a need to focus on primary prevention.

Physical activity

In a 3-year study[41] among children it was found that initial fat mass was the dominant factor influencing increasing adiposity; however, aerobic fitness was also a significant independent predictor of increasing adiposity in this cohort of children. Physical activity declines in girls immediately before puberty[42]. It has been postulated that physical activity or fitness during childhood serves as the foundation for a lifetime of regular physical activity[43]. Strong evidence shows that physical activity results in modest weight loss and increases cardiovascular fitness independent of weight loss[44]. The prevalence of overweight children was significantly related to the amount of time (hours per day) that the children spent watching TV or videos[45].

Obesity and risk for other diseases

There are significant associations of raised fatty streaks with the risk factors for adult CAD (e.g., non-HDL cholesterol and HDL-cholesterol concentrations, hypertension, smoking, obesity, and impaired glucose tolerance), and these associations became evident in the late teenage years, earlier than the associations with grossly detected raised lesions.[46] Since obesity is related to clustering of risk factor variables in children and young adults, the prevention of the onset of obesity in early life may be important to reducing the risk of coronary heart disease in later life[47]. Longitudinal studies of children followed into young adulthood suggest that overweight children may become overweight adults, particularly if obesity is present in adolescence[48].

Because overweight is associated with various risk factors even among young children, it is possible that the successful prevention and treatment of obesity in childhood could reduce the adult incidence of cardiovascular disease.[47, 49-51] Women (and men) who were overweight adolescents are less likely to marry, have lower household income, and complete fewer years of school.[52] Whereas women have no increased risk of mortality, men with adolescent overweight are about twice as likely to die (from all causes or coronary heart disease) compared to lean men.[53] Adolescent overweight also has social, economic, and psychological consequences.[52] Odds ratio for being overweight (75th percentile) at age 35 is about 2-4 for those who are overweight in 8-18 years of age[13]. Among all hospital discharges, proportion of discharges with obesity-associated diseases increased dramatically in the past 20 years.[54]

Socioeconomic status

Higher the economic status, higher is the incidence of overweight, and more so in females as compared to males.[6,8,55] There is a powerful inverse relation between obesity and socioeconomic status in the developed world, especially among women.[56] Children of parents with less income and formal education have greater body fatness associated with greater television watching and other sedentary activities.[57]

Perceptions

Increase in body weight and girth has often been perceived as being both healthy and attractive and as a sign of increasing affluence and wealth of the family.[58] While overweight status was associated with increased unhealthy weight-control behaviors, many of the overweight adolescents accurately perceived themselves as overweight, reported that they cared about controlling their weight, and had engaged in healthy weight-control behaviors during the past

year.[59-60] Pubescent girls between 11 and 14 years are 3-6 centimeters taller, and 4-6 kg heavier than non-pubescent girls.[61]

METHODOLOGY

Defining the variables

Obesity is an excess of body fat frequently resulting in a significant impairment of health. It results when the size/number of fat cells in a person's body increases. A normal-sized person has 30-35 billion fat cells. When a person gains weight, these fat cells first increase in size and later in number. One pound of body fat represents about 3,500 calories. The Expert Committee on the treatment and prevention of obesity and the International Task Force on obesity suggests "BMI is an accurate and easily available method to screen for childhood obesity". The proposed reference standard for **o**besity is:

$$\textbf{Body Mass Index (BMI)} = \frac{\textbf{Weight (in Kg.)}}{\textbf{Height (in Meters}^2\textbf{)}}$$

The classification of the BMI is given in Table-1.

Table-1. Classification of BMI

Level of obesity	Under wt.	Normal	Over wt.	Obese	Obese	Extreme obese
BMI	<18.5	18.5-24.9	25.0-29.9	30.0-34.9	35.0-39.9	> 40

Height

Height was taken using a standard three piece anthropometric rod at their classrooms corrected up to 1 mm. Students were asked to stand upright against a wall with the heels touching the wall and the chin held horizontally so that the tragus of the ear and the eye are in a straight line, then the rod was adjusted and the height in cm was read.

Weight

Weight of all students was taken using bathroom scales calibrated at the Legal Metrology department and corrected with a lever balance up to 0.5 kg and calibrated daily for zero error. The students were asked to stand upright, bare footed on the weighing machine looking straight while the measurement was read.

Age

Assessment of age is important to know whether or not the subjects belong to the adolescent group and to assess prevalence with age. Age was recorded in completed years of life and rounded to the nearest year. Adolescent age was taken from 13 to 19 years. Age at menarche was looked at because numerous studies have shown that overweight/obese children attain menarche at an earlier age than normal. I wanted to see whether in this sample too the same trend is seen or not.

Socioeconomic status

Students were asked about household monthly income, type of house, parents' education and occupation as proxy for socioeconomic status. Household income (< Rs. 1,000, 1,000-4,999, 5,000-15,000 and > 15,000), type of housing - *kutcha* (mud/thatched wall & roof), *pucca* (brick/stone wall, tiled/asbestos/tin roof) and *semipucca* (mudwall & tiled/asbestos/tin roof or brick/stone wall & thatched roof), educational qualification of parents (primary, secondary, pre-degree, graduate, postgraduate & above), and parents' occupation (unemployed, manual labour, business, service, and others were the socioeconomic indicators considered by this study.

Family history

Family history of overweight/obesity was assessed by asking the students to identify their parents/siblings and grandparents as normal/overweight/obese based on their perception.

Illness and medication

Questions were asked about the type and duration of current medication (allopathic, ayurvedic, homeopathic and others), past medication, hospitalization and lost school days of the students. This is to know whether long use of drugs such as steroids used for asthma/others could have contributed to increase in weight, or whether overweight/obese children were more prone to illness or not and also to see if long periods of hospitalization had lead to immobility and therefore contributed to increase in weight.

Diet and physical activity

A food frequency table, with 35 items of food and columns indicting the number of times (home or outside) and quantity in one sitting, was used to assess the diet. This is the normal routine diet the students had, not in marriages/parties; items which they did not have were written as 'N'. Those columns left blank were taken as no responses.

Physical activity was measured by asking about residential distance from school/tuition centre, mode of conveyance, routine work at home (how long and how often), outdoor games (daily/ weekly), participation in sports with regular practice, daytime sleeping (how long), TV watching, computer use (daily and weekly), and hobbies (how long).

Girls were asked whether they had any restrictions in diet or physical activity after menarche and if so what. This was asked because the diet pattern changes after menarche in many girls with emphasis on eating more eggs, milk, fruits and other nutritious food which may influence the increase in weight and also majority of the girls are restricted from outdoor games which will hamper their physical activity.

Perception and awareness

Students were asked whether they knew their bodyweight, how often they recorded it, how they perceived themselves (normal/underweight/overweight/obese), whether they dieted, whether conscious about their weights and did something to maintain it, and whether overweight/obesity was a problem and if so, the problems caused by it; they were asked to select a picture which was closest to what they would like their body to be in future. This is to understand what the students thought about overweight/obesity and how this can help in preventing the problem.

Study area and subjects

This cross-sectional study was done in the urban population of one Corporation (Thiruvananthapuram) and 4 Municipalities (Neyyattinkara, Attingal, Nedumancaud, Varkala) and the rural population of the *panchayats* in the Thiruvananthapuram district of Kerala, which has high enrolment ratio and literacy rate.[62] Besides, the district has a large number of schools and colleges with a good mix of students from all levels in the society. The study was conducted among students between the age group of 13-19 yrs (studying in classes 8-9th, 11th classes, degree 1st & 2nd year); 10th and 12th classes were excluded as the students were studying for their final examinations.

Sampling frame

Sampling frame consisted of all schools and colleges (Government/Private, aided/unaided, SSLC/CBSE/ICSE) except special schools for disabled children and professional/training colleges. Training colleges had students above 19 yrs while professional colleges had students from other districts as well. Information on all schools was obtained from Directorates of Public Instruction, Higher Secondary Education, Vocational Higher Secondary Education, and Collegiate Education.

Schools/colleges were stratified into rural/urban, exclusive girls/boys, and coeducation. The status was confirmed by school/college authorities and the concerned Directorate. A total of 322 schools and 26 colleges were included.

Sampling

Study population included all students of 13-19 yrs of age. Since no study has been done in this population before, a prevalence of 8% was taken. Sample size (N) was calculated using the formula $4pq/d^2$ (prevalence = 8%, d = ± 2% and q = 0.92) yielding N=736. Since only class divisions, not individuals, were selected, additional 40% (N = 736+294 = 1,030) were added to make the sample more representative and compensate for the design effect. Students were randomly selected and rural/urban children were differentiated based on their place of residence. A sample of 131 students from 3 schools where children from high-income families studied too was included. A Multistage Stratified Random Sampling Technique was used to select the participants (students who were present in the randomly selected division/class on that day).

Stage-1

The sample included 232 rural schools (18 boys only, 15 girls' only & 199 both boys & girls), 90 urban schools (11 boys, 19 girls, and 60 both), 9 rural colleges (all coeducation) and 17 urban colleges (3 girls' only & 14 both). Given this, the stratified frame had the possibility of 12 strata and one school each was selected from each stratum randomly.

Stage-2

Once the schools were selected, a list of all the divisions of 8^{th}, 9^{th} and 11^{th} classes were taken separately for rural and urban schools and the required number of class divisions was selected randomly. A total of 713 school students (210 from 8^{th}, 226 from 9^{th}, and 277 from 11^{th}) and 342 college students (153 from 1^{st} year and 189 from 2^{nd} year) were recruited for the study. Thus a total of 1,055 students were included in the study.

Research team included the principal investigator and 2 assistants (students from Centre for Child Development) trained to take anthropometric measurements (height using a 3-piece anthropometric rod up to 1 mm precision and weight using a calibrated bathroom scales up to 0.5 kg precision).

Method of data collection

Data was collected using a pre-tested self-administered questionnaire distributed in the classroom after telling them what the study is about and taking the verbal consent of the

students. Anyone not interested was allowed to keep away. Each question was explained while the students filled them up with clarification of doubts. Simultaneously, height and weight were measured. The entire process took about 1 - 1.5 hrs. Pamphlets on adolescent health, BMI and graphs by which the children can know their BMI were distributed. Calculation of BMI and steps to undertake for a healthy and fit body were also explained to them.

Study tools

Questionnaire

Questions were asked about identity, socioeconomic status, diet (using food frequency table), physical activity, bodily perceptions and menstrual history. Validation was done by cross-checking the information (esp. on diet, educational qualification & occupation of parents, age at menarche, household income and physical activities) with mothers of about 5% samples over telephone.

Case study

Students from 3 unaided schools in the city where children from affluent families study were chosen for a case study. Classes were selected in such a way to maintain the uniformity with the study sample and all the students present in one division were included. A total of 131 students were selected for the case study.

Data analysis

Data was coded and compiled using Microsoft EXCEL software and analyzed using SPSS. Quantitative analysis using univariate/bivariate analysis was also done.

RESULTS

Sample characteristics

The sample consisted of 1,055 adolescent (13-19 yrs) students from 6 schools and 6 colleges of Thiruvananthapuram district. Mean age of the sample students was 15.6 yrs (15.5 yrs for boys and 15.7 yrs for girls). About two-third of the students belonged to the forward community while the rest belonged to backward class (25.7%), scheduled class (11.1%), and scheduled tribe (1.7%).

Fathers of 60.8% of students had secondary (10^{th}) education and 36.7% had pre-degree/ graduate/postgraduate/above; the rest (2.5%) did not know the status. One-third was casual labour, 12.3% were in business, 45.5% were salaried, and 5.2% were retired, temple priest etc. More than half (55.5%) of the students did not know the household income, while 13.6%

reported a monthly income of < Rs. 1,000/- and 1.8% reported an income in excess of Rs. 15,000/-. Majority (77.1%) had good house while 19% had average and 4% had poor houses. Half of them studied in government, 39.4% private aided and 10.5% private unaided schools/ colleges.

Prevalence of overweight/obesity

Prevalence of overweight/obesity was 5.4% (mean BMI = 19.1, SD = 3.2) – 5.2% among boys (18.9, 3.4) and 5.5% among girls (19.30, 3.0). The difference between boys and girls was statistically insignificant (Chi test, P = 0.81). Table-2 provides the results. Fathers of 10.9% students and mothers of 13.0% were found to be overweight/obese; 4.2% of siblings were also overweight/obese.

Table-2. Categorization based on BMI

BMI	Frequency (%)	Girls (%)	Boys (%)
Overweight	50 (4.7)	33 (5.4)	17 (3.8)
Obese	7 (0.7)	1 (0.2)	6 (1.3)
Normal	505 (47.9)	314 (51.2)	191(43.2)
Underweight	493 (46.7)	265 (43.2)	228(51.6)
Total	1055 (100)	613 (100)	442 (100)

Physical activities

Table-3 reports the results concerning the physical activities. About 50% (48.4%) lived within 5 km from the school and 22.7% traveled > 10 km. Only 26.8% of students walked/cycled to school. More than 75% did some routine work (sweeping, swabbing, shopping, agriculture/ gardening, washing clothes/utensils, fetching water, and cooking) at home and with 46.1% did it everyday. Over 60% went for tuitions (1 – 14 times/week) and most of them went to places < 1 km from their residence; 60.7% walked/cycled. Nearly half of them (70.6% for boys, 25.8% for girls) were involved in outdoor games; only 11.8% did so for > 8 hrs/week. One-fourth played daily for at least 1 hr; others played during weekends. Only 15.5% (31.2% for boys, 4% for girls) were active members of sports team having regular practice sessions.

Three-fourth of the students watched TV daily for 1-5 hrs. Half of them used computers; 33% used it for < 8 hrs/week. It was found that only 8.5% did not use TV/computer. About 75% spent 2-8 hrs/week on hobbies and 35% slept during daytime.

Perception and awareness of overweight/obesity

About half of the students were aware of their present bodyweight and most of them perceived their bodyweight rightly (Table-4). Majority (70.7%) of adolescents considered themselves to be normal, 14.7% to be underweight, 13.2% to be overweight and 1.4% to be obese. Though 63.1% of the students said that they were conscious about maintaining their bodyweight, only 26.6% resorted to efforts to maintain their bodyweight. More than two third of the students (68.6%) consider obesity to be a problem citing reasons such as medical (33.1%), difficult to move (36.1%), body image (4.2%), unhealthy (4.6%), inability to participate in sports (3.0%), and shameful (5.4%). One-tenth 10.6% tried to reduce their weight by running, walking, cycling, exercise, yoga, dancing and dieting.

Table-3. Physical Activity

Variables	Number of Students	Percentage
Distance from school		
0 to 5 kms	511	48.4
5 to 10 kms	305	28.9
More than 10 kms	239	22.7
Mode of conveyance		
Not using vehicles	283	26.8
using motor vehicles	772	73.2
Routine Home work		
Doing routine work	830	78.7
Not doing routine work	225	21.3
Outdoor games per week		
No outdoor games	585	55.5
1- 8hrs per week	345	32.7
More than or equal to 8hrs	125	11.8
Member of Sports Team		
Member of sports team	163	15.5
Not a member	892	84.5
TV/PC weekly		
No TV/PC Weekly	90	8.5
Less than 8hrs	248	23.5
8hrs or more	717	68.0
Hobbies		
No Hobbies	300	28.4
Involving Physical activity	307	29.1
No Physical activity	448	42.5

When pictures of different body images (very lean, lean & fit, muscular, overweight, and obese) were shown, 52% of boys preferred a muscular body, 32.6% preferred a lean & fit body, and 13.6% preferred a very lean body as adults in future. Among girls, 73.1% preferred a lean & fit body and 20.7% preferred an overweight body type. In Kerala, girls are preferred to be a little plump rather than lean and so the preference is also similar.

Table-4. Perception and awareness of overweight/obesity

Variables	Number of Students	Percentage
Awareness on Bodyweight		
Know body weight	492	46.6
Don't know body weight	563	53.4
PerceiveBodyWt		
Normal	746	70.7
Underweight	155	14.7
Overweight	139	13.2
Obese	15	1.4
Conscious about maintaining bw		
Yes	666	63.1
No	389	36.9
Conscious efforts to maintain bw		
Yes	276	26.2
No	779	73.8
SpecialDiet		
Taking spl diet	75	7.1
Not taking	980	92.9
Perceive Obesity as a problem		
Yes	724	68.6
No	331	31.4
Conscious efforts to Prevent OverWt/obesity		
Yes	130	12.3
No	925	87.7

Menstrual history

Among 613 girls, those who attained menarche were in the age group of 12-14 yrs. Many girls experienced restrictions both in diet and physical activity after menarche. It was found that 14.4% had diet alteration after menarche. Most of them were asked to have more nutritious food (37.5%) specifically milk, eggs and fruits. Some (25%) were asked to increase the quantity of food or to reduce it (2.3%). Physical activity was restricted in 14.5% of girls.

Diet pattern

All were asked to write the number of times they consumed any of the 34 food items both outside and at home in a normal routine week and mention the quantity eaten in one sitting. The list included food items like *dosa, idli, puri, putt, appam, uppuma, chapatti, vegetables, rice, kanji, tapioca, fruits, fruit juices, fish fry& curry, chicken, mutton, beef, pork, egg, biriyani, noodles, milk, curd, butter/ghee/cheese, and other fast food and snacks like pastries, sweets, bakery items, burgers/cutlets, fried foods* and *fizzy drinks*. Table-5 provides the dietary pattern of students. Although foods like *dosa, idli, puri, putt, appam, uppuma, rice, tapioca, noodles,* and *chapatti* did not show much difference between boys and girls, boys ate more *kanji* and vegetables; non-vegetarian food except fish curry was also common among boys. Boys also had more fruit juices.

Age and prevalence

Overweight/obesity was high among 15 and 16 yrs (Figure-2); it was low among 13 yrs. Among girls, prevalence was high among 15 yrs and among boys, it was high among 17 yrs. Prevalence increased steadily as age increased from 13 to 15 yrs and decreased up to 18 yrs and showed a rise at 19 yrs.

Urban-rural difference

Prevalence was high among urban students (6%) compared to rural students (4.8%); but it was not statistically significant. Urban schools also showed higher prevalence (6.1%) than the rural schools (4.6%); but the difference was not significant. Prevalence was high (7.2%) among those studying in private unaided schools followed by private aided schools (5.5%) and government schools (4.9%); but the difference was not significant.

Socioeconomic Status

Among those who knew the income, as income increased prevalence of over wt./obesity too increased steadily (Table-6). Also, prevalence was high among those living in pucca houses

(6.0%) compared to those in semi pucca or kutcha houses. Prevalence also increased with better occupation of the father. Fathers' educational qualification also showed a difference in the prevalence.

Family History

Family history of overweight/obesity is very important in this study as numerous studies have shown the genetic trait as important for the prevalence of obesity. Here, the parents and siblings are reported as overweight/obese according to the perception of the student. As seen in Table-7, prevalence was 13% among adolescents who perceived their fathers to be overwt./obese. This finding substantiates the earlier studies that children with overweight/ obese parents have more risk of being overweight/obese. Similarly, prevalence was 12.4% among adolescents who perceived their mothers to be overweight/obese. If a child was single (without siblings), prevalence was high (7.3%).

Physical Activity

Sedentary lifestyle and lack of physical activity contributed most to the prevalence of overweight/obesity (Table-8). When the distance of school increased from the place of residence, prevalence also increased. Prevalence among those using vehicles was 5.8% compared to 4.2% among those walked/cycled to school. Those students who did routine work at home at least twice a week had a lower prevalence compared to those who did not do any work; this relation was significant. Prevalence between those who did not play (5.6%) and those who played (6.4%) was not significantly different. Being an active member of any sports team with regular practice sessions show a reduced prevalence of 4.3% compared to others

Figure-2. Prevalence of Overwt/Obesity with Age

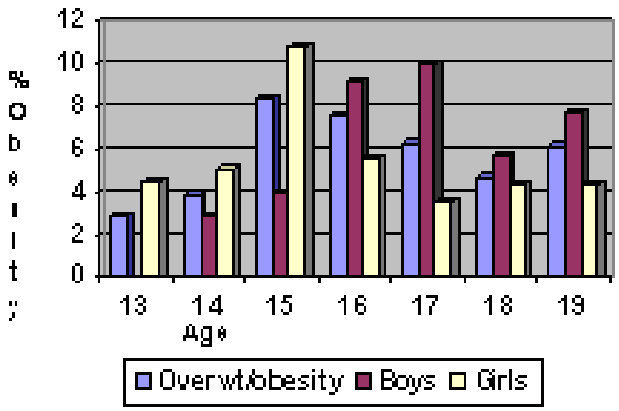

Table-5. Pattern of consumption of some common food items by adolescents

Variable	Male (%)	Female (%)
Dosa	434 (98.2)	590 (96.2)
Puri	217 (49.1)	267 (43.6)
Idli	363 (82.1)	527 (86.0)
Putt	275 (62.2)	351 (57.3)
Appam	322 (72.9)	429 (70.0)
Uppuma	137 (31.0)	194 (31.6)
Chappati/parotta	282 (63.8)	369 (60.2)
Vegetables daily	364 (82.4)	472 (77)
Rice daily	433 (98.0)	604 (98.5)
Kanji	181 (41.0)	174 (28.4)
Tapioca	202 (45.7)	260 (42.4)
Biriyani	133 (30.1)	83 (13.5)
Noodles	85 (19.2)	118 (19.2)
Fruits	268 (60.6)	390 (63.6)
Fruit juice	113 (25.6)	98 (16.0)
Fish curry	314 (71.0)	422 (68.8)
Fish fry	289 (65.4)	358 (58.4)
Chicken fry	92 (22.2)*	39 (6.5)*
Chicken curry	191 (43.7)*	189 (31.4)*
Mutton	71 (16.1)	53 (8.6)
Beef	105 (23.8)	53 (8.6)
Egg	345 (78.6)*	436 (71.2)*
Pastry	96 (22.1)*	142 (23.4)*
Sweets/chocolates	216 (49.5)*	266 (43.9)*
Snacks (chips/mixture/fried)	197 (44.8)*	281 (46.0)*
Burgers/cutlets/puffs/pizzas/etc	166 (37.6)	188 (30.9)*
Fizzy drinks	199 (45.0)	147 (24.0)*
Drinks (frooty/njoi/etc)	105 (23.8)	79 (12.9)*
Butter/ghee/cheese	71 (16.2)*	122 (19.9)*
Milk/curd	333 (75.5)*	414 (67.5)
Ice cream	159 (36.0)	134 (22.3)

* non response

Table-6. Socioeconomic Status and Prevalence

Household Monthly Income	Non Overwt/ obese	Overwt/ obese	Total	'p' Value
Don't Know	561 (95.9%)	24 (4.1%)	585	**0.022**
<1000Rs	138 (95.8%)	6 (4.2%)	144	
1000-4999Rs	153 (94.4%)	9 (5.6%)	162	
5000-15000Rs	131 (90.3%)	14 (9.7%)	145	
>15000Rs	15 (78.9%)	4 (21.1%)	19	
Type of House				
Kutcha	40 (95.2%)	2 (4.8%)	42	**0.23**
Semipucca	194 (97.0%)	6 (3.0%)	200	Not
Pucca	764 (94.0%)	49 (6.0%)	813	Significant
Occupation of father:				
Manual labour	351 (97.8%)	8 (2.2%)	359	**0.009**
Business	121 (93.1%)	9 (6.9%)	130	
Service sector	443 (92.5%)	36 (7.5%)	479	
Others	52 (94.5%)	3 (5.5%)	55	
Father's educational qualifications:				
Don't know	27 (96.4%)	1 (3.6%)	28	**0.190**
Upto SL	609 (95.2%)	31 (4.8%)	640	Not
> SL	362 (93.5%)	25 (6.5%)	387	Significant
Total	998	57	1055	

Medical History

Among those (28%) under medication, 7.1% were overweight/obese compared to 4.7% among others. Prevalence was high among those using indigenous system of medicine (7.7%) than those using Allopathy (4.7%). Hospitalization was low among overweight/obese children.

Awareness and Perceptions of Bodyweight

As shown in Table-9, among the obese those who were conscious had a higher prevalence of overweight/obesity (6.5%) than those who were not conscious (3.6%). Similarly, those

who knew of their bodyweight and checked it at intervals had higher prevalence (6.5%) than those who did not (4.4%). Among the overweight/obese those taking special diet had a higher prevalence of 13.3% compared to 4.8% in those not taking special diets. Among the obese, 42.1% made conscious efforts to maintain bodyweight. Those making efforts to maintain bodyweight had higher prevalence (8.7%).

Table-7. Family History & Prevalence of Overwt/Obesity

Overwt/obsity in father	**Non Over obese**	**Overwt./ obese**	**Total**	**P. Value**
Yes	100 (87%)	15 (13%)	115	
No	889 (95.5%)	42 (4.5%)	931*	
				<0.001
Overwt/obsity Mother			***9passed away**	
Yes	120 (87.6%)	17 (12.4%)	137	
No	874 (95.7%)	39 (4.3%)	913	**<0.001**
Overwt/obesity in Sibling			***5 passed away**	
Yes	36 (81.8%)	8 (18.2%)	44	
No	873 (95.4%)	42 (4.6%)	915	**<0.001**
Single Child	89 (92.7%)	7 (7.3%)	96	
At least 1 sibling	909 (94.8%)	50 (5.2%)	959	

Menstrual history

Prevalence was high among those who attained menarche at an earlier age of 10-12 yrs. As the age at menarche increased, prevalence decreased. Similarly prevalence was high (12.4%) among those whose physical activity was restricted than others (4.7%).

Diet

Although 35 food items were included in the food frequency table, everyday routine food like dosa, idli, uppuma, appam, puri, rice etc did not show much difference between the overwt/obese and non overwt/obese and was not significant. A majority of overwt./obese students ate noodles, biriyani and other non-vegetarian items (except fish curry) compared to others (Table-10). Similarly, they consumed sweets, fizzy drinks, snacks, pastries, milk, butter, ice cream, and chocolates.

Table-8. Physical Activity and Prevalence of Overwt/Obesity

Distance of residence from School	Non Overwt/ obese	Overwt/ obese	Total	'p' Value
0-5 kms	487 (95.3%)	24 (4.7%)	511	**0.605**
5-10 kms	287 (94.1%)	18 (5.9%)	305	Not
>10kms	224 (93.7%)	15 (6.3%)	239	significant
Conveyance to School				
Using Vehicles	727 (94.2%)	45 (5.8%)	772	**0.312**
Not Using Vehicles	271 (95.8%)	12 (4.2%)	283	Not
				significant
Routine work				
Yes	791 (95.3%)	39 (4.7%)	830	**0.05**
No	207 (92%)	18 (8%)	225	
Outdoor Games				
No	552 (94.4%)	33 (5.6%)	585	**0.12**
1-8hrs/week	323 (93.6%)	22 (6.4%)	345	Not
>8hrs/week	123 (98.4%)	2 (1.6%)	125	significant
Member of Sports Team				
Yes	156 (95.7%)	7 (4.3%)	163	**0.496**
No	842 (94.4%)	50 (5.6%)	892	Not
				significant
Time Spent On TV/PC				
None	230 (96.3%)	15 (6.1%)	245	**0.543**
<8hrs/week	581 (95.2%)	29 (4.8%)	610	Not
>8hrs/week	187 (93.5%)	13 (6.5%)	200	significant
Hobbies				
Involving Physical Activity	293 (95.4%)	14 (4.6%)	307	**0.088**
Not Involving Activity	416 (92.9%)	32 (7.1%)	448	Not
Total	709	46	755	significant
Tuition				
Yes	633 (94.6%)	36 (5.4%)	669	**0.967**
No	365 (94.6%)	21 (5.4%)	386	Not
				significant
Conveyance to Tution				
UsingVehicles	231 (92%)	20 (8.0%)	251	**0.05**
Not Using Vehicles	372 (96.1%)	15 (3.9%)	386	
Daytime Sleep				
Yes	346 (94.5%)	20 (5.5%)	366 (34.7%)	**0.94**
No	652 (94.6%)	37 (5.4%)	689	Not
Total	998	57	1055	significant

Table-9. Awareness and perceptions of Body weight

Conscious about Body wt.	Non Overwt/ obese	Overwt/ obese	Total	'p' Value
Don't Know	561 (95.9%)	24 (4.1%)	585	**0.022**
Yes	623 (93.5%)	43 (6.5%)	666	**0.04**
No	375 (96.4%)	14 (3.6%)	389	
Know their Bodywt				
Yes	460 (93.5%)	32 (6.5%)	492	**0.139**
No	538 (95.6%)	25 (4.4%)	563	Not
Special diet				Significant
Yes	65 (86.7%)	10 (13.3%)	75	**0.002**
No	933 (95.2%)	47 (4.8%)	980	
Conscious Efforts to Maintain Bodywt				
Yes	252 (91.3%)	24 (8.7%)	276	**0.005**
No	746 (95.8%)	33 (4.2%)	779	
Among overwt/obese-42.1%	Among non overwt/obese-25.3%			
Perception of own body				
Underwt	153 (98.7%)	2 (1.3%)	155	**<0.001**
Normal	731 (98.0%)	15 (2.0%)	746	
Overwt	103 (74.1%)	36 (26.7%)	139	
Obese	11 (73.3%)	4 (26.7%)	15	
Perception of obesity as a problem				
Yes	682 (94.2%)	42 (5.8%)	724	**0.39**
No	316 (95.5%)	15 (4.5%)	331	Not
Trying to prevent overwt/obesity				Significant
Yes	106 (81.5)	24(18.5)	130	**<0.001**
No	892 (96.4%)	33(3.6%)	925	
Total	998	57	1055	

Table-10. Diet and prevalence of Overwt/obesity

Item	Non Overwt/ obese	Overwt./ obese	Total	P. Value
Noodles home	171 (17.1%)	32 (56.2%)	203	**<0.001**
Biriyani	198 (19.8%)	18 (31.8%)	216	**0.155**
Fish fry	609 (61.0%)	38 (67.7%)	647	**0.12**
Chicken curry home	345 (34.6%)	35 (64.2%)	380	**<0.001**
Chicken fry	103 (10.3%)	28 (49.1%)	131	**<0.001**
Sweets home	71 (7.1%)	6 (10.5%)	77	**0.09**
Sweets outside	452 (46.6%)	30 (53.6%)	482	**0.80**
Fizzy drinks	312 (31.3%)	34 (59.6%)	346	**<0.001**
Snacks	433 (43.6%)	45 (78.9%)	478	**<0.001**
Pastries	210 (22.%%)	28 (49.1%)	238	**<0.001**
Butter	173 (17.9%)	20 (35.1%)	193	**0.002**
Choclates	369 (38.0%)	50 (87.7%)	419	**<0.001**
Milk	699 (70.1%)	48 (84.2%)	747	**0.005**
Ice cream	259 (26.2%)	34 (59.6%)	293	**<0.001**
Burgers	316 (32.1%)	38 (66.7%)	354	**<0.001**

Results of the case study

As it may be recalled, the case study included 131 students from private unaided schools. Prevalence of overweight/obesity was found to be very high (12.2%) compared to the study samples.

Age

Case study indicated that the prevalence was highest (17.9%) at 16 yrs followed by 14 yrs (15.0%); it was 9.3% even at 13 yrs. Students residing in urban areas had relatively high prevalence compared to rural students. However, rural schools showed as a higher prevalence. This could be because though the school is situated in a rural area outside the corporation limits students are all from urban areas.

Socioeconomic status

Prevalence was not related to the family income among this group of students although prevalence was high (12.5%) among those whose fathers had higher (beyond secondary)

education compared to others (10.5%). Similarly, it was very high (25.0%) among students whose fathers were in business.

Family history

Prevalence was high (30.8% compared to 7.5% among others) among students whose fathers were overweight/obese. The same cannot be said about the mothers although obesity status of the siblings did influence the prevalence (33.3% compared to 8.0% for others). Similarly, students without siblings also had a higher (24.0%) prevalence compared to those who had siblings (9.4%).

Physical activity

Prevalence was 16.2% among those who lived more than 5 kms from school compared to 7.9% living closer. Those whop used motor vehicles had a higher (12.7%) prevalence in relation to those who walked/cycled (5.3%). Prevalence steadily declined as the time spent on outdoor games increased (no outdoor games 18.8%, 8 hrs/week play 13.8%, and > 8 hrs/ week 3.6%). Time spent with TV/computer also increased the prevalence.

Medical history

Those who were on medication (indigenous) had a prevalence of 18.2% compared to 8.3% among those using allopathic medicines. Prevalence was 28.6% among those who were hospitalized compared to those who were not hospitalized (11.5%). This finding is opposite to that in the study sample where those hospitalized had a lesser prevalence. This could be because most of the students hospitalized in this sample were for fracture and not for other illnesses as in the case of study sample.

Awareness and perceptions of body image

As in the case of study population, those who were conscious of their bodyweight, knew their bodyweight and made conscious efforts to maintain bodyweight had higher prevalence. Among those who perceived themselves to be overweight/obese, 63.4% were not overweight/obese. Those who considered obesity to be a problem also had a higher prevalence and those with higher prevalence were doing some exercise to prevent overweight/obesity.

Diet

Those who had *kanji, tapioca* and *biriyani* had high prevalence. Similarly, those ate non-vegetarian food had high prevalence. Mutton and beef when bought from restaurants showed high prevalence ($P = 0.05$).

Discussion

Prevalence of overweight/obesity among school going children of rural and urban adolescents aged 13-19 years was found to be 5.4% taking the BMI criteria of the IOTF. An earlier study done in a Delhi Public school by Dr.Umesh Kapil[6] was my reference study with a prevalence of obesity to be 7.4% and prevalence of overweight/obese to be 52.4%. Since there was paucity of data on prevalence of overweight/obesity among adolescents in the state of Kerala and since I was taking the whole district including rural and urban areas into focus I had taken a lower prevalence of 8% as the prevalence for overweight/obesity. Boys showed a higher prevalence of obesity (1.4%) than girls (0.2%) while girls showed higher prevalence of overweight (5.4%) than boys (3.8%) similar to the findings in the Delhi study but the overall prevalence of overweight/obesity was more in females (5.5%) than males (5.2%).

A school based study in Chennai[7] done in adolescents girls 10-15yrs old of affluent families found a prevalence of 9.6% overweight and 6% obese. In the case study taken from children of affluent schools it was found that they had a prevalence of 7.2% of overweight/obesity with higher prevalence of obesity in males and overweight in females. The high prevalence of overweight obesity in adolescents is important because obese adolescents become obese adults thus increasing the risks of various diseases. This has been proved in many other studies in the past and is being researched even today to find the exact etiology. It has been found that prevalence in higher ages is reflective of overweight/obesity in adulthood[41,47,48,53,54] In the present study the maximum prevalence in adolescents was found in the age group of 15-16yrs.Males showed maximum prevalence at 16-17yrs and females at 15yrs unlike the Delhi study where the maximum prevalence of obesity was at 10-12yrs. In the Chennai study prevalence peaked at 10,13 &15yrs. This increase may be due to the pubertal growth phase, but is followed by a decrease as the adolescents become more conscious of their body image.

There was no significant difference in the prevalence in different religions and other studies also substantiate this fact. Though some studies have shown significant difference in the prevalence with religion I did not find any significant relation between the two. The higher prevalence of overweight/obesity among Hindus in this study could be because of the larger number of students being Hindus Socioeconomic status of the adolescent showed a higher prevalence with high SES and lower with low SES. This was based on proxy measures like adolescents living in pucca houses, fathers' with better occupation and fathers with higher education showed higher prevalence of overweight/obesity. Numerous studies[6,25,55,56,57] have

shown this earlier . Most of the people in Thiruvananthapuram have pucca houses and as service sector of people are more there is more equity in the socioeconomic status. The difference in prevalence is seen when the occupation of the father is considered Better education means better job and therefore better socioeconomic status and it may also reflect the rearing up practices at home. A person with better education may want to bring up his children with better food. Children may have more pocket money and may eat more from outside especially bakery items and junk food. The case study prevalence of overweight/ obese substantiates this finding since the adolescents were from affluent families. The rural urban differences in the prevalence was based on the area of residence of the adolescent and area of the school and it was found that those living in urban areas and those in urban schools showed a higher prevalence than those in rural areas. This rural and urban difference is not significant in Thiruvananthapuram as there is no marked difference between urban and rural areas. This is also seen when the prevalence is taken using the area of the school. The differences in type of school, Government, private aided and unaided was also examined and prevalence of overweight/obesity was found to be more in unaided school 7.2% compared to 5.5% in aided and 4.9% in govt: This was not seen in literature review of other studies. To further strengthen this fact it was seen that when a sample from unaided schools was taken as a case study it showed a definite increase in prevalence of 12.2%.The genetic component of obesity etiology was bought out in this study too where the presence of overweight/obesity in the parents both mother and father and sibling increased the prevalence of overweight/ obesity in those adolescents. Thus family history of obesity was substantiated. This has been seen earlier in many studies where parental obesity increased the prevalence; twins had higher prevalence if one was obese and also the genetic component[25,26,27,28]. Here it is to be noted that parents obesity leading to increased prevalence in children is not only due to the genetic factor but also because of the lifestyle practices and diet pattern followed in that household which are very important etiological factors in the prevalence of overweight/obesity. This study also showed that being a single child increased the prevalence of overweight/ obesity probably due to the more attention and pampering by the parents and more pocket money available. This was seen in the Delhi study where obesity was more in nuclear families[6].

The importance of physical activity in the prevalence of obesity was evident from the present study. No routine work done at home, use of motor vehicles and increased distance of residence from school increased the prevalence. This is probably because children living closer to the school may be walking or cycling while those far off may be traveling by vehicles. Lack of outdoor games, more time spent on TV/PC and pursuing hobbies involving no physical

activity was related to higher prevalence. This has been seen in earlier studies and it was found that sedentary activity, lack of sports are one of the main causes of this rapid increase in obesity in the whole world[6,41,42,43,44,45].

In this study it was also seen that adolescents who slept during the daytime at least twice a week showed a higher prevalence than those who did not, again reflecting the sedentary behavior. It was found that being on continuous medication for more than 2weeks and using indigenous system of medicine increased the prevalence but prevalence was low among the adolescents who were hospitalized. Though there are hypothesis about the affect of certain drugs on obesity nothing has been proved definitely. From this study it is not proposed that the use of indigenous medicine as seen in Table leads to overweight or obesity but it was a finding when asked about the type of medicine used. It is seen that obese children are healthier and have fewer hospitalization but in the case study there was higher prevalence of overweight/obesity among those who were hospitalized because most of them were hospitalized for fracture and not for any other illness. This was seen in previous studies which said that just obese or Grade one obese are generally healthy and the morbidity increases in moderate and severe obesity[59].

Perception and awareness was more among the adolescents already overweight or obese about maintaining body weight, dieting and own body image and almost 69% of the adolescents knew that overweight and obesity is a problem but many did not know what caused it or what the consequences of overweight were and obesity. Most of them among the obese perceive their own body image well but 11% of the non overweight/obese adolescents thought themselves to be overweight or obese. This is a danger sign which also cautions that strong recommendations at school level to prevent overweight/obesity may on the other hand increase the prevalence of underweight which is already a big problem. The previous studies have also shown that perception among the adolescents is good among the obese though some societies consider overweight and obese to be normal and healthy[57,58,60.].It has been found in this study that 'fast foods', noodles, snacks, pastries, butter, ice cream, fizzy drinks, chocolates and milk are highly significant in increasing the prevalence of overweight/obesity. Non vegetarian food particularly chicken curry and fry especially eaten from outside increased the prevalence.

In the past 10years in Kerala there has been a tremendous growth in the number of fast food joints and the frequency of children eating out has also gone up, coupled with the increase number of children with 'pocket money'. All this has changed the diet to a high fat, high sugar

low fibre diet and resulted in increase of prevalence. Similar diet patterns have shown high prevalence in various other studies too[29,30,31,32,40].

Though there have been many studies relating early age of menarche with overweight/obesity this study could not get significant relation of overweight/obesity with age of menarche[61].But it was seen that as the age of menarche increased the prevalence rates decreased and most of the overweight/obese with high prevalence attained menarche between 10-12 years while the others attained at 12-14 yrs mainly. It was also found that 15% of the adolescent girls had alteration in their diet and restriction to physical activity after they attained menarche. Most of them had increased the quantity of nutritious foods, eggs, milk and fruits and all of them had been restricted from playing outdoor games. This was not found in the other studies though it was found in many studies that outdoor games decreased in girls as age increased in adolescents[42].

Thus from this study it is evident that factors like family history, urban rural differences, diet pattern and lack of physical activity and sedentary lifestyles have led to overweight/obesity and though it is low compared to the previous studies in India, it is time to think of strategies to curb this epidemic at the earliest lest it should run out of control. So Interventions programmes should be thought of with emphasis to 'catch them young'. Intervention should start in the early teens when they are most receptive as they start becoming conscious about their body image and want to maintain a good body image. School intervention programmes would help as has been shown in several studies across several countries[34,35,39,]. Diet control and education on the type of food to be eaten, importance of increased physical activity and behavior change are to be emphasized as shown from different studies[33,36,37,38].

Strengths and limitations

The whole study was done by a single investigator who had supervised each questionnaire filled and measurements taken by the two trained assistants. A large sample was selected to represent the whole population of school/college going adolescent of Thiruvananthapuram district. Both the rural and urban areas of the district had been covered in the study. The study was carried out not only as a survey but also a service as pamphlets were distributed to each and every student who took part in the study about adolescent health, a health education class was taken on the calculation of BMI, how to calculate it and charts showing the ideal BMI for each age was distributed. At certain colleges and schools a session was held separately after the questionnaires were filled and measurements taken to explain facts on obesity and clear the students' doubts about diet, type of food and ideal weight for height.

The **limitations** of the study are that it was not a community based study and since it was cross sectional survey no causal relationships can be established from this study. Though the study was of adolescents between 13-19yrs of age there was incomplete representation of 15 and 17year olds who were excluded from the study. Recall bias among the children especially about the diet and presence of overweight and obesity may have confounded some findings. Proxy measures of SES and perceptions of the students which are subjective were a limitation but since these are widely used in NFHS surveys and KAP studies, it may not be considered as a grave limitation.

Conclusions

The prevalence of overweight/obesity among the school/college going adolescents of urban and rural Thiruvananthapuram District is 5.4%. There was a strong association of this prevalence with family history of overweight/obesity in the parents and sibling. Rural urban differentials were also observed, though not statistically significant. Private unaided school students and lack of physical activity also showed an increase association with the prevalence. The awareness and perceptions about obesity as a problem is high but knowledge about the causes and consequences of overweight/obesity is not satisfactory. Dietary pattern especially 'fast food', fizzy drinks, chocolates and ice creams, snacks, pastries and milk were highly significant in increasing the prevalence of obesity. Though age at menarche was not significantly associated diet alteration and physical activity restrictions did contribute to higher prevalence. Around 74 % of the girls did not play any outdoor games at all and only 12% of the adolescents were involved in regular games every week.

Recommendations

School intervention programmes are the best approach to advocate and encourage methods to prevent overweight/obesity. This can be done by active participation by teachers and the government or management of the schools to encourage physical activity by having games or sports periods where all are encouraged to participate. Health education on nutrition can be given either by the teachers or external dignitaries under the science clubs or health clubs of the school. It may be noted that approaching only children will not solve the problem, through the children we should be able to reach the families too either through mothers meetings or PTA functions where a nutrition expert may spell out the importance of the problem and guide them. Schools may also stop the sale of junk food and fizzy drinks in the canteens where most of the school students frequent. Fast food joints popularizing high fat, high sugar and low fibre diet should be curbed by at least making it compulsory that they write the calories in each meal they offer in the menus or menu boards.

The physical activity in children may be encouraged by 'walk to school' programs and urban areas where traffic is more and parents fear children walking or cycling due to accidents, separate closed paths may be placed on either side of the road by the Government through which pedestrians and cyclists can travel safely. In giving out such messages one has to be very cautious in a state like Kerala where under nutrition also co-exists with obesity. Hence very high stress on less calorie intake to bring down obesity may prove counterproductive by pushing down more of normal weight children to under nutrition levels and may aggravate the already existing under nutrition among them. From this angle also, encouraging more physical activities including sports and games looks more feasible. Kerala is a state with very little data on the overweight/obesity status in children and adolescents. The present study throws light upon many issues relating to overweight and obesity which was previously no known. More studies have to be done to clearly understand where we stand before taking further steps.

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