DETERMINANTS OF OBESITY AMONG ADOLESCENT SCHOOL CHILDREN IN AN URBAN AREA OF KANCHEEPURAM DISTRICT, TAMILNADU - A CASE CONTROL STUDY

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ABSTRACT

This case control study was carried out among adolescent school children in an urban area of Kancheepuram District to assess the socio-demographic, nutritional, behavioural, antenatal and postnatal determinants of adolescent obesity. To determine the socio-demographic factors associated with obesity among cases and controls. To assess the nutritional factors associated with obesity among cases and controls and determine the behavioural factors associated with obesity among cases and controls. Though there is a National Adolescent Health Programme in India, the strategies of the programme do not specifically address obesity as a public health problem.

Keywords
Obesity, physical activity, adolescent and dietary patterns.

Introduction

Obesity is defined as "an abnormal growth of the adipose tissue either due to enlargement of size of fat cells (referred to as hypertrophic obesity) or due to increase in number of fat cells (referred to as hyperplastic obesity) or both". First obesity is generally expressed in terms of Body Mass Index (BMI). Obesity is one of the significant contributors to ill health and the prevalence has nearly tripled worldwide since 1975. Obesity is one of the most common chronic disorders in both adults and children. In 2016, more than 1.9 billion adults were overweight out of which nearly 650 million people was obese. According to the World Health Organization (WHO), a child is defined as "a person younger than 19 years of age unless national law defines a person to be an adult at an earlier age". When a person falls into the category of 10 to 19 years, they are referred to as an "adolescent". [1-3] Obesity is a preventable risk factor and the prevalence of obesity is increasing in children including adolescents. Nearly 340 million children including adolescents were overweight or obese in the year 2016. Between 1975 and 2016, the rates of obesity have increased more than four-fold among children including adolescents. For children, age and sex need to be considered when defining overweight and obesity and WHO has given clear cut definitions for those aged between 5 -19 years.[4]

At the same time, these children are exposed to food items with high fat and salt content, more calories but less micro nutrients. These dietary patterns, in synergy with low levels of physical activity, result in sharp rise in childhood obesity while undernutrition issues remain unresolved.[5-8]

Prevalence of overweight and obesity in adolescents The prevalence of overweight and obesity among children including adolescents in the age group of 5-19 years has risen drastically from 4% in 1975 to 18% in 2016. This increase is noted in both boys and girls. In the year 2016, 19% of boys and 18% of girls were overweight worldwide. In 1975, around 1% of children aged between 5 -19 years were obese, whereas in 2016, this proportion has increased to 7% (6% in boys and 8% in girls). Overweight and obesity ranks higher in mortality worldwide than underweight. [7]

Aetiology of obesity and overweigh The fundamental cause of obesity and overweight is an energy imbalance between calories intake and output. 21 The aetiology of obesity is complex and multiple factors play a role in development of obesity. Among them, non-modifiable risk factors are age, sex, ethnicity and genetic factors. Modifiable risk factors are physical activity, socio-economic status, eating habits, psychosocial factors and endocrine disorders. [2]

Reducing the content of fat, salt and sugar in processed foods Ensuring that healthy and nutritious foods are available and within the purchasing power to all consumers Limiting the marketing of foods which have high sugars, salt and fats, especially those foods targeting the children and teenagers Response to the rising burden of obesity In the year 2004, the World Health Assembly adopted the "WHO Global Strategy on Diet, Physical Activity and Health (DPAS)" which describes the actions that are essential to encourage healthy diet intake and regular physical activity. The Strategy invites all stakeholders to take necessary actions at global, national and regional levels to bring a sustainable improvement in the physical activity patterns and dietary intake at the population level. [9,10]

MATERIALS AND METHODS

Study Design
The present study is a school based Case Control study conducted in an urban area of Kancheepuram district, Tamil Nadu.

Study area
The study was carried out in Chromepet, which is an urban residential area in Kancheepuram district, Tamilnadu where SreeBalaji Medical College and Hospital is situated. Chromepet is a calm residential locality where various schools and colleges are located. This area is around 22kms from Chennai Central railway station. It lies on both sides of the Grand Southern Trunk road.

Chromepet comes under Tambaramtaluk, which has a total urban population of 3,56,322 according to 2011 census. 91 Among them, 1,80,321 are males and 1,76,001 are females. The total number of households are 91,201 and the land area is around 62.5 sq.km. The literacy rate is nearly 83% and the sex ratio is 976 females for 1000 males. 91

Study population
The population covered in this study was school children between the age 10-17 years, studying in V standard to XII standard. Study period The study was conducted between November 2018 and April 2019.

Inclusion criteria
Students for the study were included based on the BMI for age and sex criteria. Willing students who had a BMI for age and sex >+2 SD of WHO growth reference median was taken as a case, and BMI for age and sex between -2SD and +1SD was taken as a control.

Exclusion criteria
Students who were not willing to participate in the study were excluded. Students who had a BMI for age and sex between +1SD and +2SD were excluded from the study who fell into overweight category and those with a BMI for age and sex less than -2SD who fell into underweight category were excluded from the study.

Statistical analysis:

Data was entered in Microsoft excel and analysed using SPSS software, version 22. The statistical analysis of the data was done using descriptive and analytical statistics. The descriptive statistics analyzed were presented as frequency distribution and percentage. The analytical statistics for categorical data used were Chi square, Odds Ratio (OR), 95% Confidence Interval (CI) and p value.

RESULTS

A total of 110 obese adolescents (cases) and 110 non-obese adolescents (controls) were included in this Case Control study. The cases and controls were group matched for age. Socio demographic characteristics, physical activity pattern, dietary habits, family history of obesity, antenatal and postnatal factors were analysed for the cases and controls. The results of the study are given below and explained with tables and figures.

Socio-demographic characteristics of the cases and controls are shown in Table 1. Nearly 53% belonged to the age group of 13-15 years. About 55.5% were females among the cases and 51.8% were females among the controls. Around 80% of cases and 78.2% of controls belonged to Hindu religion. With regard to educational status of the father, around 50.9% among cases and 60% among controlshave completed graduate degree. Around 60% of mothers of both cases and controls have completed graduate degree.

Socio-Economic Status was categorized according to Modified Kuppuswamy classification (updated February 2019). Nearly 54.5% of the cases belonged to upper middle class, 30% to lower middle class, 10% to upper class, and 5.5% to upper lower class. Similarly, among the controls, 70% were in upper middle class category, 16.4% in upper class and 13.6% in lower middle class. About 34.5% of cases and 4.5% of controls were the only child in the family. Nearly 84.5% of the children among cases and 73.6% among controls belonged to nuclear type of family.

Table 1: Socio demographic characteristics of the obese and non-obese adolescents

S.No	Characteristic	Obese adolescents (N=110)		Non-obese adolescents (N=110)	
		Frequency	Percentage	Frequency	Percentage
1.	**Age in years**				
	10-12 yrs	30	27.3	30	27.3
	13-15 yrs	58	52.7	58	52.7
	16-17 yrs	22	20.0	22	20.0
2.	**Gender**				
	Male	49	44.5	53	48.2
	Female	61	55.5	57	51.8
3.	**Religion**				
	Hindu	88	80.0	86	78.2
	Christian	16	14.5	19	17.3
	Muslim	6	5.5	5	4.5
4.	**Education of father**				
	Professional or Honours	25	22.8	32	29.1

|					
	Graduate degree	56	50.9	66	60.0
	Intermediate or post high school diploma	24	21.8	12	10.9
	High school	5	4.5	-	-
5.	**Education of mother**				
	Professional or Honours	-	-	16	14.5
	Graduate degree	65	59.1	66	60.0
	Intermediate or post high school diploma	11	10.0	22	20.0
	High school	34	30.9	6	5.5
6.	**Occupation of father**				
	Professional	6	5.5	8	7.3
	Semi-professional	42	38.1	26	23.6
	Clerical	5	4.5	22	20.0
	Skilled worker	33	30.0	35	31.8
	Semi-skilled worker	18	16.4	17	15.4
	Unskilled worker	6	5.5	-	-
	Unemployed	-	-	2	1.8
7.	**Occupation of mother**				
	Professional	-	-	4	3.6
	Semi-professional	22	20.0	10	9.1
	Clerical	11	10.0	14	12.7
	Skilled worker	5	4.5	15	13.6
	Semi-skilled worker	-	-	15	13.6
	Unskilled worker	11	10.0	-	-
	Unemployed	61	55.5	52	47.4
8.	**Socio-economic class (Modified Kuppuswamy classification 2019)**				
	Upper	11	10.0	18	16.4
	Upper middle	60	54.5	77	70.0
	Lower middle	33	30.0	15	13.6
	Upper lower	6	5.5	-	-
	Lower	-	-	-	-
9.	**No.of.siblings**				
	Nil (single child)	38	34.5	5	4.5
	One	72	65.5	105	95.5
10.	**Type of family**				
	Nuclear	93	84.5	81	73.6
	Joint	11	10.0	24	21.8
	Three generation	6	5.5	5	4.6

Comparison of Dietary habits of obese and non-obese adolescents

The dietary patterns were analysed and compared between the obese and non-obese adolescents (Table 2). About 17.3% of cases and 10.9% of controls had the habit of skipping breakfast. Increased consumption of fast food was noted among 40% of cases and 21.8% of controls. Increased intake of chocolates or sweets were reported by 35.5% of cases and 11.8% of controls. Adequate fruits intake was reported by 42.7% of cases and 60% of controls. Adequate vegetables intake was noted in 20.9% among cases and 24.5% among controls. The habit of increased visits to restaurants was noted in 15.5% of cases and 10.9% of controls. Parents' restriction in allowing children to buy snacks was noted among 57.3% of cases and 81.8% of controls.

Table 2: Dietary habits of obese and non-obese adolescents

| S.No	Factor	Obese adolescents (N=110)		Non-obese adolescents (N=110)	
		Frequency	Percentage	Frequency	Percentage
1.	**Habit of skipping breakfast**				
	Yes	19	17.3	12	10.9
	No	91	82.7	98	89.1
2.	**Increased fast food consumption**				
	Yes	44	40.0	24	21.8
	No	66	60.0	86	78.2
3.	**Increased intake of chocolates/sweets**				
	Yes	39	35.5	13	11.8
	No	71	65.5	97	88.2
4.	**Fruits intake**				
	Adequate	47	42.7	66	60.0
	Inadequate	63	57.3	44	40.0
5.	**Vegetables intake**				
	Adequate	23	20.9	27	24.5
	Inadequate	87	79.1	83	75.5
6.	**Increased visits to restaurants**				
	Yes	17	15.5	12	10.9
	No	93	84.5	98	89.1
7.	**Liberty to buy snacks without restriction by parents**				
	Yes	47	42.7	20	18.2
	No	63	57.3	90	81.8

Figure 1: Time spent in physical activity by obese and non - obese adolescents
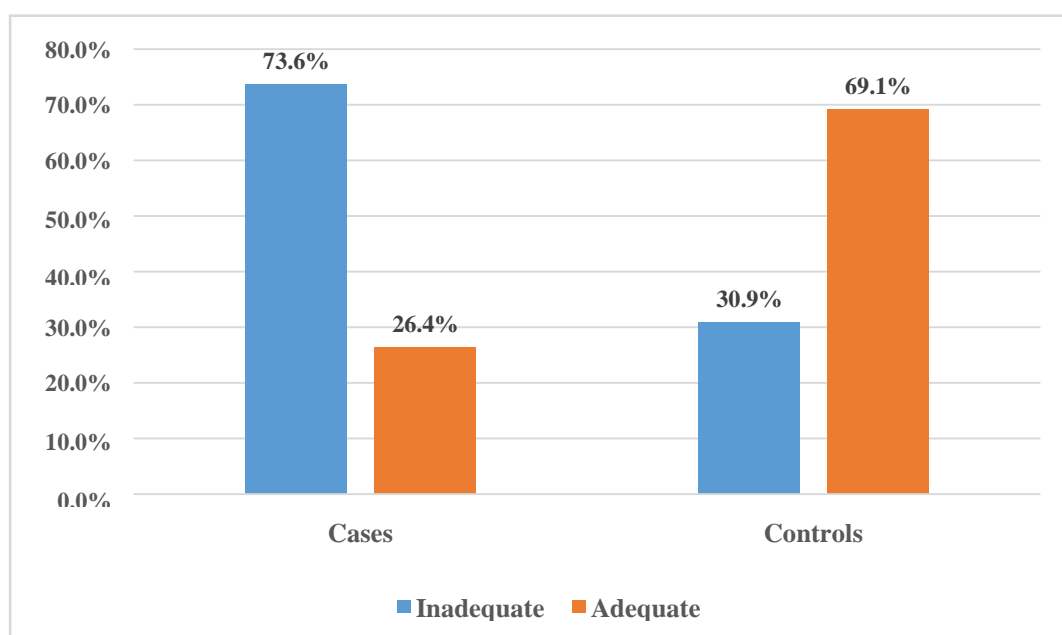
Antenatal and postnatal history among cases and controls

Certain factors in antenatal and postnatal period can play a role in development of obesity in adolescents and they are presented in Table 4. History of maternal gestational diabetes was noted among 3.6% of cases and 1.8% of controls. About 17.3% of cases and 10.9% of controls had increased   birth weight (Figure 2). History of exclusive breast feeding was reported by the mothers of 35.5% of cases and 65.5% of controls.

**Figure 2: Comparison of birth weight among cases and controls**
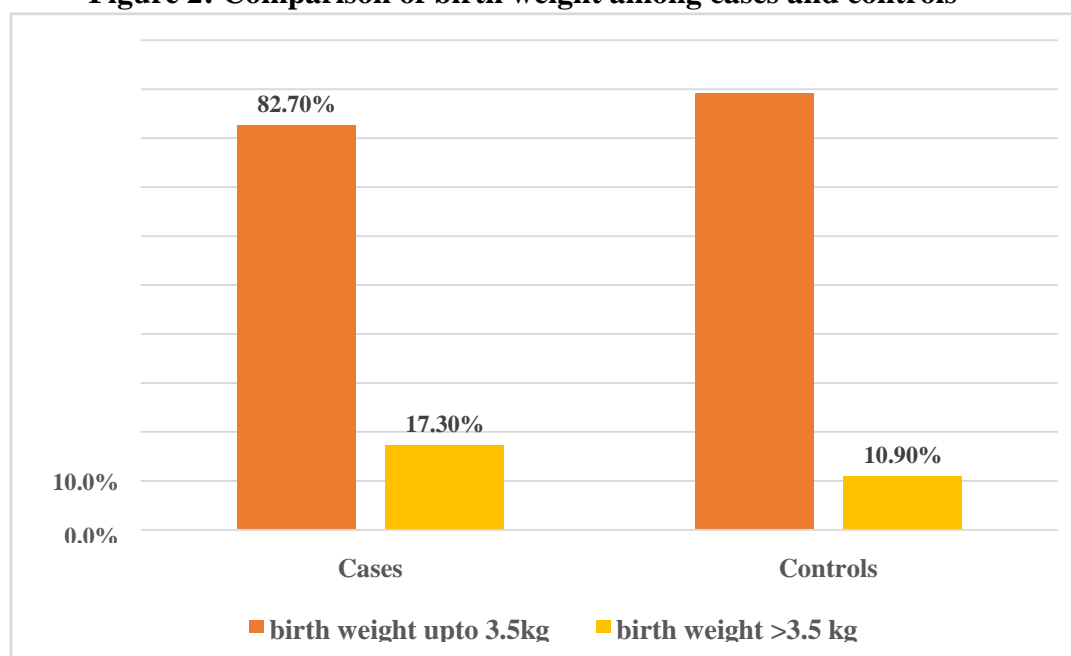
Family history of obesity among cases and controls

The percentage of children who had atleast one obese parent is presented in Figure 3. About 30.9% of cases and 14.5% of controls had an obese father or mother. Figure 4 shows a comparison of obesity among siblings of cases and controls. Nearly 13.6% of cases and 10% of controls had a sibling who is obese.

Figure 3: Comparison of parental obesity among cases and controls
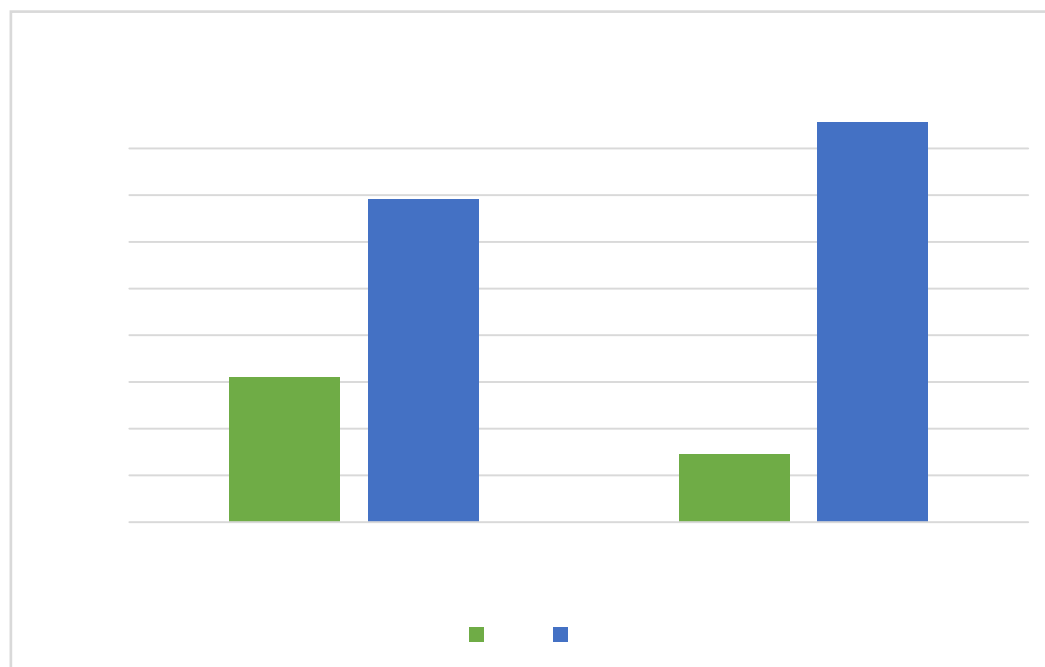
Figure 4 : Comparison of waist hip ratio among cases and controls
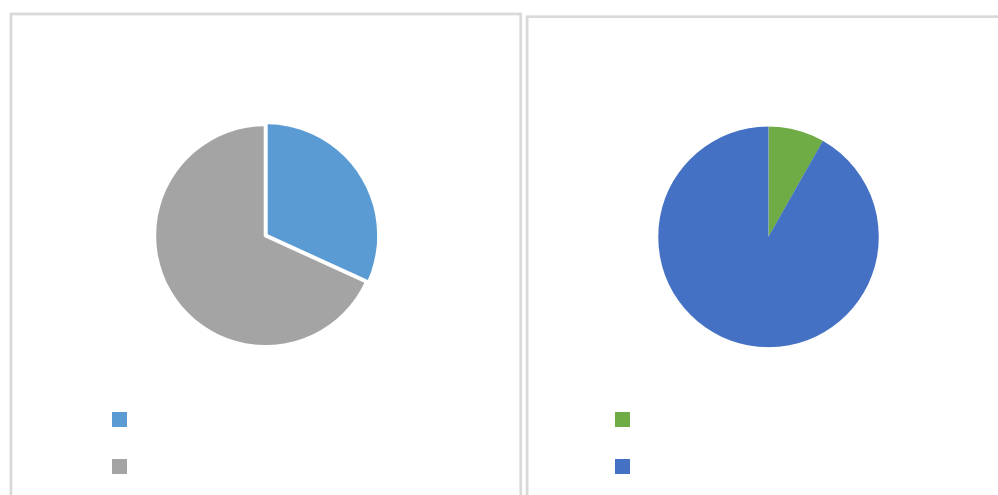
Menstrual history was elicited from adolescent girls who have attained menarche (Table 3). Out of total 49 obese girls, 57.1% had regular menstrual cycles. Out of total 47 girls in the control group, 80.9% reported regular cycles. Among cases who had irregular cycles (n=21), 23.8% had taken treatment for the same. Menstrual flow was reported as normal by 77.6% of cases and 87.2% of controls.

Table 3: Comparison of Menstrual history of adolescent girls

S.No	Characteristic	Obese girls (N=49)		Non-obese girls (N=47)	
		Frequency	Percentage	Frequency	Percentage
1.	**Menstrual cycle**				
	Regular	28	57.1	38	80.9
	Irregular	21	42.9	9	19.1
2.	**If irregular, any treatment taken**				
	Yes	5	23.8	-	-
	No	16	76.2	9	100
3.	**Menstrual flow**				
	Normal	38	77.6	41	87.2
	Heavy	-	-	-	-
	Scanty	11	22.4	6	12.8

Family history of obesity among cases and controls is given in Table 9. The odds of developing obesity is 2.6 times higher for adolescents who had atleast one obese parent compared to those adolescents whose parents were not obese (OR-2.62, 95% CI:1.3-5.1, p value-0.003). Having an obese sibling didn't show statistical significance between the cases and controls.

Table 4: Family history of obesity and its association with adolescent obesity

S.No	Factor	Obese	Non-obese	OR (95% CI)	Chi square	p value
1.	**Obese parent**					
	Yes	34	16	2.62 (1.3-5.1)	8.39	0.003*
	No	76	94	ref		
2.	**Obese sibling**					
	Yes	15	11	1.42 (0.62-3.25)	0.69	0.4
	No	95	99	ref		

OR: odds ratio; CI: confidence interval; ref: reference
*p<0.05 statistically significant at 95% CI

Among the adolescent girls (49 cases and 47 controls), the association between menstrual symptoms reported by the girls with adolescent obesity was studied. Irregular menstrual cycles,

which is usually a complication of obesity was noted more among obese adolescent girls (OR-3.13, 95% CI: 1.26-8.19, p value-0.02). There was no statistically significant association between menstrual flow and obesity.

Table 5: Menstrual symptoms and its association with adolescent obesity

S.No	Factor	Obese (N=49)	Non- obese (N=47)	OR (95% CI)	Chi square	p value
1.	**Menstrual cycles**					
	Irregular	21	9	3.13 (1.26-8.19)	5.22	0.02*
	Regular	28	38	ref		
2.	**Menstrual flow**					
	Scanty	11	6	1.96 (0.66-6.26)	0.95	0.33
	Normal	38	41	ref		

OR: odds ratio; CI: confidence interval; ref: reference
*p<0.05 statistically significant at 95% CI

DISCUSSION

This Case-control study was done to assess the determinants associated with obesity among adolescent school children. The study was conducted in an urban area of Kancheepuram district and included 110 cases and 110 controls selected from the study population. Many interesting results were obtained from the present study and were explained already. Findings of the study are discussed in comparison with similar studies done in different settings.

In the present study, we didn't find an association between gender and adolescent obesity. Similar finding was noted in a study by Maruf et al in a study done among school going adolescents in Nigeria (p value >0.05). 104 Whereas in a Case control study by Menezeset el among adolescents in Brazil, obesity found a positive association with males compared to females (OR: 2.25, p value <0.006). [11]

In the Case control study by Bhuiyan et al, maternal education was assessed for its association with adolescent obesity but it was not statistically significant (OR: 1.1, p value >0.05). 63 Educational level of parents plays a role in development of adolescent obesity. Adolescents whose parents are less educated are more likely to become obese because of inadequate knowledge of the parents on healthy food selection, physical activity and weight control.[12,13]

In the present study, we didn't find a significant association between socio-economic class and adolescent obesity. This could be because of the fact that this case control study was done in private schools and majority of adolescents, both cases and controls were from affluent families. Whereas Rathnayake KM et al in a case control study done in Srilanka among adolescent girls noted high socio economic status as a factor associated with obesity (OR: 3.42, p value: 0.001). [7,14] Similarly, Piryani et al in a study from Nepal also noted upper socio-economic class as a factor associated with adolescent obesity (OR: 4.26, p value <0.001). 105 On the contrary, in a study by Cook et al among adolescents, low socio economic class was noted as a risk factor for adolescent obesity. [15-18]

In the present study, increased chocolates or sweets intak e was found to be associated with adolescent obesity. Similarly, in the study by Rexlin et al done in Madurai, unhealthy food

habits like snacking on sweets and chocolates was reported as a risk factor for adolescent obesity (OR: 2.04, p value: 0.03). 89 Similar finding was noted in a study by Nisak et al done in Surabaya, Indonesia (p value: 0.028). Bo et al in their study done in Italy analysed the dietary habits of a cohort of 400 adolescents and reported increased frequency of intake of chocolates as a risk factor for adolescent obesity (p value <0.05).115 Intake of energy dense foods coupled with minimal or no physical activity can contribute to development of obesity among adolescents.[19]

In the present study, having an obese parent was found to be a factor associated with adolescent obesity (OR: 2.62, p value: 0.003). Similarly, Bhuiyan et al in a case control study done among adolescents in Dhaka, Bangladesh noted that having atleast one overweight parent as a risk factor for adolescent obesity (OR: 2.7, p value <0.05). [20] In a case control study by Menezes et el in Brazil, obesity had a positive association with mother's BMI (OR: 3.45, p value <0.0001). 64 Panda SC in a study among adolescents in Burla, Orissa reported family history of obesity as a risk factor for adolescent obesity (chi square: 4.11, p value: 0.04) 77 But in the study by Rexlin et al, parental obesity didn't show statistical significance with adolescent obesity (chi square: 1.38, p value: 0.2). [21]

In the present study, irregular menstrual cycle was noted as a factor associated with adolescent obesity among girls (OR: 3.13, p value: 0.02). Similar finding was reported from the case control study by Rathnayake et al (OR: 4.47, p value: 0.001).60 This could be physiological, as the menstrual cycles of adolescents are irregular due to immaturity of the hypothalamic-pituitary-ovarian axis during the initial years after menarche. But, more than 90% of the cycles will be within the range of 20 -45 days.[10] In the present study, the irregularity in menstrual cycles was noted more among obese adolescent girls compared to their non-obese counter parts.This could be due to the endocrine effects of obesity affecting the menstrual cycles. In later stages of life, it can lead to menstrual disorders, polycystic ovary syndrome and infertility.[22]

CONCLUSION

This Case-control study assessed the socio-demographic factors, physical activity pattern and dietary habits associated with obesity among adolescent school children in an urban area of Kancheepuram district, Tamilnadu. The total sample size was 110 cases and 110 controls and adolescent students were selected from schools using the WHO BMI for age and sex criteria. The cases and controls were group matched for age and about 52.7% were in the age group of 13 -15 years.

About 44.5% of cases and 48.2% of controls were boys. Comparing the educational qualification of the father, nearly 74% have completed graduate or higher degree among cases and 89% among controls. Similarly, 60% of mothers of cases and 74.5% of mothers of controls have completed graduate degree or higher qualification. The socio-demographic factors, dietary factors, physical activity pattern, antenatal and postnatal history, menstrual symptoms for girls were analysed to determine the association with adolescent obesity.

This case control study highlights various risk factors associated with adolescent obesity. Low physical activity and improper dietary intake leads to development of obesity in the adolescent period. This can continue in the later stages of life and lead to complications of obesity, thereby affecting the quality of life in adulthood. Similarly, the advantages of exclusive breast feeding during infancy need to be reinforced as it has an impact on growth and development in adolescence.

Public Health programmesbased on physical education need to be planned at the national level to increase awareness on the factors associated with development of obesity among adolescents. Interventions can be designed at various settings and among them, schools are the prime areas to target the adolescents for health promotion activities.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGMENTS

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