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Prevalence of obesity and associated sociodemographic factors among adolescents in Udham Singh Nagar, Uttarakhand, India

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Abstract

Obesity is global health concern due to its steadily rising prevalence and major risk factors for several obesity related comorbidities. This study aimed to determine the prevalence and sociodemographic factors of obesity among adolescents. A school-based cross-sectional study was conducted on 1101 school-going adolescents of 12 – 17 years studying in class 6 to 9. Anthropometric measurements were taken. The overall prevalence of overweight and obesity was estimated to be 10.4% and 4.1%, considering IAP reference standards as cut – offs. Altogether, overweight and obesity involve 14.4% of the sample. Obesity was higher in early adolescents, private school, joint family, lower socio- economic status, higher parental educational level, in high income families and in first birth order adolescents. Overweight/obesity prevalence should be taken into consideration as adolescent obesity is marker of adulthood obesity and is associated with increased rate obesity related comorbidities in adult population. A preventive programmed action considering these factors must be planned for reducing obesity among adolescents in the society.

Keywords: Obesity, comorbidities, IAP reference standard, parental education, adulthood obesity

Introduction

Overweight and obesity prevalence has increased dramatically in developed countries and almost in whole world among children and adolescents (Lobstein *et al.*, 2004) [24]. Overweight and obesity global prevalence increased by 4.5 fold from 1975 to 2016 among 5 – 19 years aged children (www.who.int/news-room/fact-sheets/detail/obesity-and-overweight). 107.7 million Children (5 – 19 years) all over the world were reported to be obese in 2015 (GBD, 2017) [11] that increased to 124 million in 2016. Apart from this, 216 million children aged 5 – 19 years were reported to be overweight (Abarca-Gómez *et al.*, 2017) [1]. The prevalence of overweight rose from 4.94% in 2003 to 6.57% in 2005 among 5–16 years Indian children (Raj *et al.*, 2007). 9.8% obesity prevalence was reported in 2006 that increases to 11.7% in 2009 among urban Indian adolescents (14 – 17 years) (Gupta *et al.*, 2011) [13]. A significant increase in obesity prevalence was seen among north Indian adolescents from 2003 to 2008 (Singhal *et al.*, 2010) [36]. In India, 17.3 million children is expected to be overweight by 2025 (Lobstein and Jackson- Leach, 2016) [23].

Obesity is global health concern due to its steadily rising prevalence and major risk factor for several chronic diseases. Sociodemographic factors such as size of family, socioeconomic status, parental educational and occupational level, marital status and family income have strong influence on overweight/obesity prevalence among adolescents (9). Adolescent obesity is marker of adulthood obesity and is associated with increased rate obesity related comorbidities in adult population.

The aim of the present study was to determine the prevalence and sociodemographic factors of overweight and obesity among school going adolescents in Udham Singh Nagar, Uttarakhand, India.

Methods

Study design: The study was cross-sectional in nature.

Study period: Data were collected for a period of 6 months from July – December, 2019.

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Sample size calculation: Considering the expected prevalence of obesity to be 11% (Chudasama *et al.*, 2017) [7] in the study population, 95% confidence interval (CI) (Baruah, 2018, Laxmaiah *et al.*, 2007) [4, 21] with 25% relative precision, design effect of 2 and 10% non-response rate (Aggarwal *et al.*, 2016) [2], the sample size came was 1094 which was rounded to 1100. The sample size was estimated by using the formula:

Sample size = $(Z)^2 * P_{exp} * (1 - P_{exp}) * DEFF/(d)^2 + 10\%$ non-response rate

Where P_{exp} = expected prevalence of disease; DEFF = design effect; d = Relative precision; Z = 1.96 at 95% confidence interval.

Study area and sampling framework: The study was conducted in Rudrapur of district Udham Singh Nagar, Uttarakhand, India. The database of school located in Rudrapur (town/ village) was procured from Website

<https://schools.org.in/uttarakhand/udham-singh-nagar/rudrapur/rudrapur>. A total of 81 schools were present in the area. Criteria taking into account for selection were school type (Government or private) and classes (6 to 10 standards). Only 13 schools met the criteria out of 81 schools. Among these 13 schools, 4 schools (two private and two governments) were selected on the basis of: popularity in the area; easy accessibility; and strength of the school. The schools were contacted for their consent. All selected schools agreed to participate. Information regarding total strength of students attending 6 to 9th standards was collected and then proportionate sampling method was used to determine the required number of students to be selected from each class of selected school to reach the desired sample size of 1100. Desirable number of students from each class was selected by simple random sampling technique. Although estimated sample size was 1100 but one extra sample got collected from Govt. 2 school (class 8). So, for the purpose of analysis, 1101 subjects were included. Table 1 presents sampling framework.

Table 1: Sampling framework

	Strength of each school (C)	Sample to be taken from each school (D)	Standard	Strength of each class (E)	Desired sample to be taken from each class(F)	Actually taken
Govt. 1	844	422	6	91	45	45
			7	198	99	99
			8	260	130	130
			9	295	148	148
Total					422	422
Govt. 2	460	230	6	52	26	26
			7	134	67	67
			8	124	62	63
			9	150	75	75
Total					230	231
Private 1	336	168	6	70	35	35
			7	106	53	53
			8	116	58	58
			9	44	22	22
Total					168	168
Private 2	560	280	6	124	62	62
			7	136	68	68
			8	146	73	73
			9	154	77	77
Total					280	280

Total strength (A = 2200), Total school (k = 4), Total sample size (B) = 1100

$D = (B/A)*C$

$F = (D/C)*E$

Selection method used - Proportionate sampling method

Ethical clearance and Consent: Ethical clearance was obtained from the University Ethical Committee of Govind Ballabh Pant University of Agriculture and Technology and permission from Principal/Head masters of the schools was obtained prior to the study. A fully informed consent was taken from subjects to make anthropometric measurements and also to collect data by questionnaire regarding various parameters under study.

Inclusion criteria: All the students of 12–17 years studying in classes VI, VII, VIII, and IX of the schools of Udham Singh Nagar District. Healthy children were included in the study.

Exclusion criteria: Schools with only up-to Standard-IV or only Standard-IX and X were excluded. The students who were unwilling to participate in the study were also excluded. Children with conditions likely to interfere with neck

circumference, such as goitre, swellings in the neck; neck deformity and abnormalities of the cervical spine were excluded from this study.

Anthropometric measurements

Height: Height was measured using standard procedure and equipment for measurement, in each selected school. Height was measured using anthropometric rod and reading was noted to the nearest 0.1 cm. Subjects were asked to stand straight with their centre of the back on the centre of the anthropometric rod, put their feet together with heels touching each other. Head does not have to touch the anthropometric rod and subject's head held in the Frankfort plane (Ministry of Health, 2008) [26].

Weight: Weight was measured in the morning or afternoon (fasting state was not necessary), using standard procedure and equipment for measurement, in each selected school.

Weight was measured using a calibrated weighing machine to the nearest 0.1 kg. Subjects were lightly dressed and without shoes. Weighing machine was calibrated weekly and before each measurement, machine was calibrated to zero and then subjects were asked to stand on the centre of the machine with head facing forward, their arms loose on sides and in relaxed state for even distribution of body weight on both feet (Ministry of Health, 2008) [26].

Criteria for defining overweight and obesity

BMI was calculated by weight (kg) divided by square of height (m²). BMI was classified based on the age- and sex-specific cut-off values of the Indian Academy of Pediatrics (IAP) for Indian boys and girls from 5- 18 years. The classification was: underweight (<3rd percentile), normal (3rd percentile to adult equivalent of BMI <23), overweight (Adult equivalent of BMI 23 to adult equivalent of BMI 26.99) and obese (adult equivalent of BMI ≥ 27) (Khadilkar *et al.*, 2015) [18].

Variables: Subject's baseline information including sociodemographic characteristics such as (age, gender, type of school, size of family, socioeconomic status, birth order, parental educational and occupational level, their marital status and family monthly income) was collected.

Age group: Subjects were also stratified into 2 age groups: Early adolescents (age 12 – 13 years) and Middle adolescents (age 14 – 17 years).

Birth order: Subjects who were first, second and third child of their parent were coded as “1”, “2” and “3”. Rest all subjects who were four, fifth and so on child of their parent were coded as “>3”.

Socio – economic status (SES): Revised Kuppaswamy's Socioeconomic Status Scale was used for classifying parental socioeconomic status with slight modification. Due to very less number of subjects in “Upper lower” and “Lower” class, these two were merged with “lower middle” class and finally classified as “Lower” class. Upper class was remained classified as “Upper” class and upper middle class was classified as “Middle” class.

Parental educational level: Parental educational level was classified according to Sharma, 2017 [34]. Seven educational qualification categories were used by Sharma, 2017 [34] namely post – graduate, graduate, upto Class XII, upto Class X, upto Class VIII, Can read and write only and illiterate as last category. For the purpose of analysis, post – graduate and graduate were coded as “high educational level”; Class XII and Class X pass as “medium educational level” and; upto Class VIII pass or those who can read and write only or were illiterate were coded as “low educational level”.

Parental occupational level: Parent's occupation category was categorized into seven groups according to Sharma, 2017 [34]. For analysis, professional and semi-professional were

merged and newly classified as “Professional”; skilled and semi – skilled were merged and classified as “Skilled/ Semi – skilled”. For other occupational category, no new coding was done.

Family income: The income categories used for the study was determined using the interactive online calculator provided at www.scaleupdate.weebly.com. According to this, seven income categories were provided which was further recoded into four categories namely “family income below Rs. 11913”, “between Rs. 11914 – 23828”, “between Rs. 23829 – 47656” and “above Rs. 47656”.

Statistical Analysis: Data were coded and statistical analyses of data were conducted using SPSS software version 16.0. Results were reported as frequency and percentage.

Results

A total of 1101 adolescents were enrolled in the study, out of these 71.5% (787) subjects were boys while 28.5% (314) were girls. Results of the study states the overall prevalence of overweight and obesity to be 10.4% and 4.1%, considering IAP reference standards as cut – offs. Altogether, overweight and obesity involve 14.4% of the sample (Table 2).

The prevalence of overweight (including obesity) and obesity was found to be higher among early adolescents than middle adolescents (overweight: 14.7% vs 13.9%; obesity: 4.2% vs 3.9%). Private school adolescents were almost three times and two times as likely to be obese and overweight (including obesity) as government school adolescents (6.0% vs 2.8% for obesity and 20.3% vs 10.4% for overweight plus obesity).

The prevalence of overweight (including obesity) and obesity was higher in birth first order adolescent girls. Obesity prevalence was almost double in joint families in comparison to nuclear families (6.1% vs 3.6%).

Overweight (including obesity) prevalence decreases as the socio- economic status increases. Obesity prevalence was higher in lower SES as compared to upper SES group (4.2% vs 3.2%). Results of the study showed highest overweight (including obesity) and obesity prevalence among subjects with higher parental educational level. Prevalence of overweight (including obesity) increases as the occupational level of the father increases and was found to be highest among professional class (21.1%). No such pattern was seen in obesity prevalence. Overweight (including obesity) prevalence was found to highest among subjects of professional mothers (21.7%) whereas obesity prevalence was found to be highest among adolescents of unskilled mothers (11.8%). Higher prevalence of overweight (including obesity) and obesity was found among subjects of married couples. Prevalence of overweight (including obesity) increases from 12.3% to 24.1% as the family income increases with highest prevalence among adolescents with parental family income greater than Rs. 47656. Similarly, prevalence of obesity also increases from 3.6% to 5.1% with increase in family income upto Rs. 23829 – 47656. Highest obesity prevalence was seen among adolescents with parental family income between Rs. 23829 – 47656.

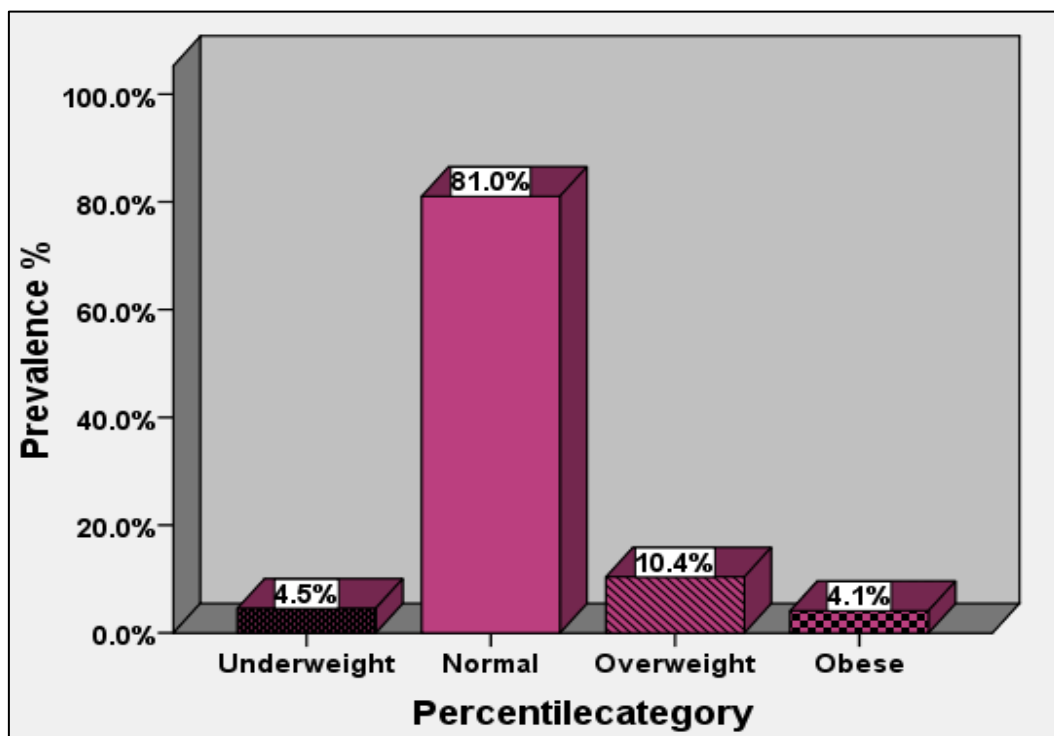


Fig 1: Overall prevalence of obesity

Discussion

Overweight and obesity in adolescents is associated with short-term and long-term health outcomes thus influencing formulation of public health policy. Therefore, regular monitoring is effective in tracking of the prevalence. The present study results reveal the association of overweight and obesity with socio-demographic factors. The prevalence of overweight (10.5%) and obesity (4.1%) found in the present study is in accordance with the findings of other epidemiological studies done in Kanpur (Watharkar *et al.*, 2015) [39], Haldwani (Aggarwal *et al.*, 2016) [2] and Karnataka - Mangalore (Kotian *et al.*, 2010) [19] and Bangalore (Philip *et al.*, 2019) [30]. Overweight/obesity prevalence rate were lower when compared with adolescents from Iran (Hajian-Tilaki and Heidari, 2012; Maddah, 2007; Mohammadpour-Ahranjani *et al.*, 2004) [14, 25, 27], Israel (Kaluski *et al.*, 2009) [17], Greece (Farajian *et al.*, 2013) [10] and higher than China (Li *et al.*, 2007) [22].

In the present study, overweight (including obesity) and obesity was found to be higher in younger adolescents. Del Mar Bibiloni *et al.*, 2010 [8] also reported similar results in which 18.8% overweight and 14.8% obesity prevalence was mentioned in young adolescents (12 – 13 years) that decreases to 16.0% (overweight) and 8.75% (obesity) in middle adolescents (14 – 17 years).

In our study, we used revised IAP growth chart 2015 (Khadilkar *et al.*, 2015) [18] for determining the prevalence of overweight and obesity and found higher prevalence among subjects of private school than government school but lower prevalence than that reported by Jagadesan *et al.*, 2014 [15] and Patnaik *et al.*, 2015 [29]. The reason for this could be attributed to the different cut-off criteria as used by Jagadesan *et al.*, 2014 [15] and Patnaik *et al.*, 2015 [29]. Thus, it can be concluded that revised IAP growth chart 2015 may be more appropriate for precisely determining overweight/obesity in Indian adolescents.

Probability of subjects getting obese was reduced when birth

order of the children was >2. Similar findings were reported by Silveira *et al.*, 2006 [35]. Obesity prevalence was not found to be clearly associated with family size. The results were comparable to that with other studies by Vohra *et al.*, 2011 [38] and Rohilla *et al.*, 2014 [32].

Consistent with past results, increasing trend of overweight and obesity prevalence was more pronounced in high income families in the present study and also by Anuradha *et al.*, 2015; El Rhazi *et al.*, 2011; and Rohilla *et al.*, 2014 [3, 9, 32]. Many previous works reported direct relationship between parental socioeconomic status and prevalence of overweight and obesity (Aggarwal *et al.*, 2016; Bharti and Kulshrestha, 2018; Chakraborty *et al.*, 2011; Kotian *et al.*, 2010; Laxmaiah *et al.*, 2007; and Namdev *et al.*, 2015) [2, 5, 6, 19, 21, 28]. However, we observed an inverse relationship between parental socioeconomic class and overweight and obesity prevalence. Similar results were reported by Jebb *et al.*, 2004 [16]; Serra-Majem *et al.*, 2006 [33]; and Vanhelst *et al.*, 2017 [37].

Parental proficiency levels appear to be the foremost relevant social issue in India for the accelerated overweight/obesity prevalence (Ghosh, 2011) [12] especially associated with observed escalation in mother's educational level. Prospective studies clearly demonstrated lower parental educational level as risk factor for obesity in developing countries (Lamerz *et al.*, 2005) [20]. However, in developing nations like India, higher parental education has influential effect on weight gain in adolescents.

It was also observed that prevalence of overweight (including obesity) was highest in adolescents with higher parental occupational level especially in working mothers. Similar results were stated by Namdev *et al.*, 2015 [28]. The possible reason for higher overweight prevalence in adolescents of working mother may be attributed to luxurious life and easy access to calorie dense variety of food items as paucity of time forces working women to rely on packed/ready to eat unhealthy food rather than self prepared nutritious food.

Table 2: Prevalence of overweight and obesity by socio - demographic characteristics

	Total	Boys	Girls	Overweight (including obesity) n (%)	Obesity n (%)
Total	1101	787	314	159 (14.4)	45 (4.1)
Age group					
12 – 13 years	712	504	208	105 (14.7)	30 (4.2)
14 – 17 years	389	283	106	54 (13.9)	15 (3.9)
Type of school					
Govt.	653	507	146	68 (10.4)	18 (2.8)
Private	448	280	168	91 (20.3)	27 (6.0)
Birth Order					
1	422	296	126	69(16.4)	24 (5.7)
2	388	268	120	49 (12.6)	14 (3.6)
3	179	134	45	30 (16.8)	5 (2.8)
>3	112	89	23	11 (9.8)	2 (1.8)
Type of family					
Nuclear	905	639	266	130 (14.4)	33 (3.6)
Joint	196	148	48	29 (14.8)	12 (6.1)
SES					
Upper	313	239	74	36 (11.5)	10 (3.2)
Middle	740	521	219	114 (15.4)	33 (4.5)
Lower	48	27	21	9 (18.8)	2 (4.2)
Educational level (father)					
High	253	157	96	52 (20.6)	13 (5.1)
Medium	467	332	135	55 (11.8)	17 (3.6)
Low	381	298	83	52 (13.6)	15 (3.9)
Educational level (Mother)					
High	150	93	57	40 (26.7)	13 (8.7)
Medium	340	233	107	45 (13.2)	9 (2.6)
Low	611	461	150	74 (12.1)	23 (3.8)
Father occupation					
Professional	142	82	60	30 (21.1)	8 (5.6)
Arithmetic skill person	301	204	97	61 (20.3)	19 (6.3)
Skilled/ semi - skilled	585	445	140	61 (10.4)	14 (2.4)
Unskilled	39	32	7	4 (10.3)	2 (5.1)
Unemployed	34	24	10	3 (8.8)	2 (5.9)
Mother occupation					
Professional	23	13	10	5 (21.7)	0 (0)
Arithmetic skill person	39	22	17	5 (12.8)	1 (2.6)
Skilled/ semi - skilled	71	43	28	8 (11.3)	3 (4.2)
Unskilled	17	10	7	3 (17.6)	2 (11.8)
Housewife	951	699	252	138 (14.5)	39 (4.1)
Marital status					
Married	1061	761	300	155 (14.6)	43 (4.1)
Divorced/ Widowed	40	26	14	4 (10.0)	2 (5.0)
Family income (Rs)					
Below 11913	359	287	72	44 (12.3)	13 (3.6)
11914 – 23828	490	349	141	62 (12.7)	20 (4.1)
23829 - 47656	198	123	75	40 (20.2)	10 (5.1)
>47656	54	28	26	13 (24.1)	2 (3.7)

Govt.: Government; **SES:** Socio- economic status.

Conclusion

To sum up, overweight/obesity prevalence should be taken into consideration as adolescent obesity is marker of adulthood obesity and is associated with increased rate obesity related comorbidities in adult population. The main risk factors associated with adolescent obesity were gender, parental educational level, family income, father occupation, socioeconomic status and type of school. A preventive programmed action considering these factors must be planned for reducing obesity among adolescents in the society.

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interest.

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