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Correspondence

Dr. Manisha Maskey
Dept. of Community Medicine
Manipal College of Medical
Sciences, Malepatan-5,
Pokhara, Nepal
Email: manzasharma@gmail.com

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Asst. Prof. Dr. Ashis Shrestha
Patan Academy of Health
Sciences

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Sciences

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Nutritional assessment of school children and adolescents: Pokhara city in Western Nepal

Manisha Maskey¹  , Laxminarasimha Sharma Annvarapu²  Poonam Karmacharya³ 

¹Lect., ²Prof., Dept. of Community Medicine, ³Asst. Prof. Dept. of Physiology, Manipal College of Medical Sciences, Nepal

Abstract

Introduction: Nutritional assessment of school children and adolescent is one of the most cost-effective ways of keeping track of overall wellbeing of children in the society. The objective of this study was to find out the nutritional status of school children and adolescent of Pokhara city using anthropometric indicators.

Method: A total of 1160 students from the schools across the Pokhara city, Nepal, were enrolled in this study. Anthropometric measurements, height and weight, mean height and weight for age, and BMI for age were estimated. Undernutrition and obesity were defined as per the 2007 WHO growth reference data. Association among the variables were determined by applying statistical tests: t-test and Anova.

Result: Growth curve of weight and BMI for age were above 15th percentile and height for age were between 3rd and 15th percentile, in both, boys and girls. The proportion of stunted and underweight students were 26.29% (boys 51% and girls 41%) and 24.65% (boys 53% and girls 47%) respectively. The proportion of thin, severely thin, overweight and obese were 3.53%, 5.03%, 12.49% and 8.96% respectively. Father's occupation and education, mother's occupation, school type, number of siblings were statistically associated with mean BMI and height.

Conclusion: Stunted and underweight were seen in a quarter of students, as well overweight and obesity in less than 10% of school children surveyed.

Keywords: children, malnutrition, nutrition, overweight, school

Introduction

Overweight and Obesity, both, are 'on the rise'.¹ At the same time, malnutrition is a public health problem in many developing nations.² The emergence of overweight and obesity are major public health problems that threatens to reverse the progress we have made in increased life expectancy in the last century.³

According to World Health Organization (WHO), nearly 40% of world's population above 18 years are overweight and 30% are obese.⁴ In children and adolescents too, from 4% in 1975, it now stands at 18 percent.⁵ Malnutrition, though still being a major public health problem in parts of Asia and Sub-Saharan Africa, is slowly changing, with more obese people in all regions of world.⁴

Nepal Demographic and health survey reports underweight (29%) and stunting (41%) are still very high among the children under 5 years of age.⁶ Individual studies, between 1983 and 2008, on the regional level indicate rise in prevalence of overweight and obesity in adults over 16 years of age.^{1,7} Nepal is going through a transitional phase where both malnutrition and overweight are seen. This study aims to find out nutritional status of school children and adolescent of Pokhara city in western Nepal.

Method

A cross sectional study of school health program was carried out from February 2019 to July 2019 in Pokhara city of province 2 (Gandaki Pradesh), Nepal. Recently nominated Pokhara-Lekhnath metropolitan city is currently going through lots of changes and urbanization.⁸

A list of schools, including government and private schools, was obtained from district education office. There were 50 schools in sampling frame (35 private and 15 public). Two separate lists of private and public schools were prepared. Out of 50 schools 7 (4

private and 3 public) were randomly selected using the lottery method. All the available and willing to participate students from grade 1 to 10, age ranging from 6 to 17 years, on the day of school visit, were included in the study. Prior to data collection, the purpose of the study was explained to the school's administration and to the students, informed consent/assent was obtained and the participation was voluntary. Approval for the study was taken from Institutional Review Committee, Manipal College of Medical sciences. Students who voluntarily agreed to participate in the study, and completed the questionnaire, and also completed the anthropometric measurement were included in the study.

Nutritional assessment was carried out by using the estimates from anthropometric measurements - weight for age, height for age and BMI for age as per WHO 2007 growth standards. Underweight is defined as the children and adolescent having weight for age < 3rd percentile, severe undernourishment is defined as the weight for age <1st percentile. Stunting and Sever stunting are defined as the children and adolescent with the height for age < 3rd and <1st percentile respectively. Thin, severely thin, Overweight and Obesity are defined as the BMI for age in children and adolescent <3rd percentile, <1st percentile, >85th percentile and >97th percentile respectively.⁹

Pre-designed questionnaire was developed based on the study objectives and used as a tool to collect all necessary information of participants. Medical students participating in school health program were thoroughly trained and were monitored during the process of data collection. Information on type of school (public and private), parent's educational status (illiterate and literate) and occupational status for father/mother (farmer, labor and office worker/housewife, work outside), total no of siblings (0-3, >3) were obtained using the questionnaire. Presence or absence of dental caries was observed (examined) directly using torch light. Visual acuity was checked using Snellen chart.

A digital weighing machine (brand SKU, brand number: 100584238_NP-1020970944) was used to measure the weight to nearest 0.1 kg and measuring tape (Komelon model: ergo 8m) for height to nearest 1cm. The students were asked to remove their shoes and stand with heels joined together. A flat wooden plank was placed on the top of the head so that it was perpendicular to the measuring tape.

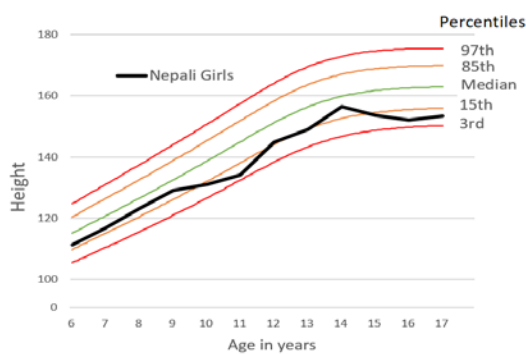
Data was first entered in a Microsoft Excel 2013 and analyzed using Statistical Package for Social Sciences (SPSS) 17 (SPSS for Windows, Version 17.0. Chicago, SPSS Inc). The association between the variables was analyzed by using the independent t-test and Anova with Tukey's correction, where appropriate.

Result

Total of 1160 students, 54.1% boys and 45.9% girls, with age ranging from 6 to 17 years. The mean height, weight and BMI in male and female students categorized by their age were statistically not significantly different, Table 1.

The mean height for age, weight for age (6 to 10 years) and BMI for age, in this study, among Nepali boys and girls plotted along the WHO 2007 growth reference curve, Figure 1, showed:

Height for age- Mean height for age in both cases, boys and girls, were found between 3rd and 15th percentile, Figure 1 & 1.1.



Weight for age- Mean weight for age in boys was almost at 15th percentile, whereas in girls it was between 15th and 50th percentile, Figure 2 & 2.1.

BMI for age- Mean BMI for age of boys was around 50th percentile and girls was between 15th and 50th percentile, Figure 3 & 3.1.

Categorization of study subjects based on their height for age, weight for age and BMI for age measurements against the WHO 2007 growth reference standards, showed:

Height for age- Out of 1160 students, 305 (26.29%) were stunted. Among them, 157 (13.5%) were stunted and 148 (12.8%) were severely stunted. Out of 305, 180 (59%) were boys and 125 (41%) were girls. The proportion of stunting was slightly high in boys in compare to girls, Table 2.

Weight for age- Out of 288 students of age 6 to 10 years, 71 (24.65%) were undernourished. Among them, 29 (10.1%) were undernourished, 42 (14.6%) were severely undernourished. Out of 71, 38 (53%) were boys and 33 (47%) were girls. The proportion of underweight was found to be high in boys in compare to girls, Table 2.

BMI for age- Out of 1160 students, 99 (8.55%) were thin (among them 58 (5.03%) were severely thin), and 145 (12.49%) overweight (among them 41 (3.53%) were obese). Out of 99 thin students, 47 (47%) were boys and 42 (43%) were girls. Among the 145 overweight students, 78 (54%) were boys and 67 (46%) were girls.

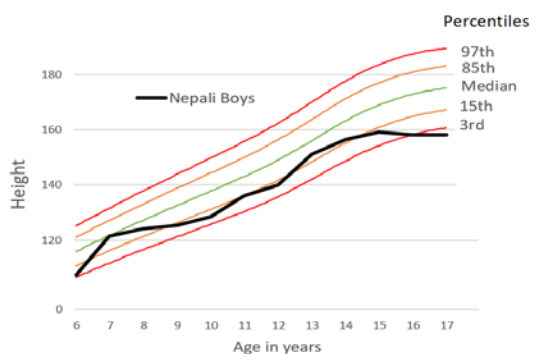


Figure 1. Mean height of Nepali boys/girls against WHO reference data

Figure 1. Mean height of Nepali school children against WHO reference data

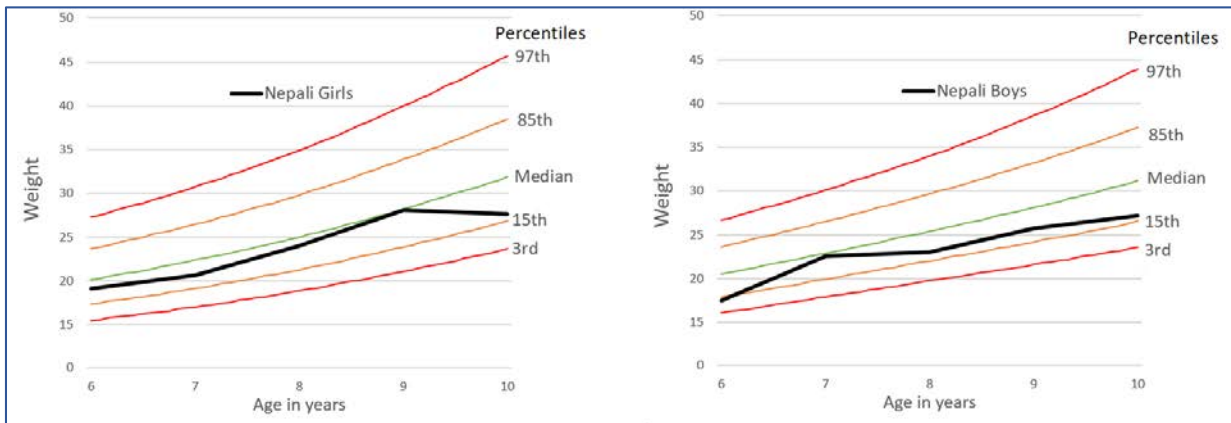


Figure 2. Mean weight of Nepali boys/girls against WHO reference data

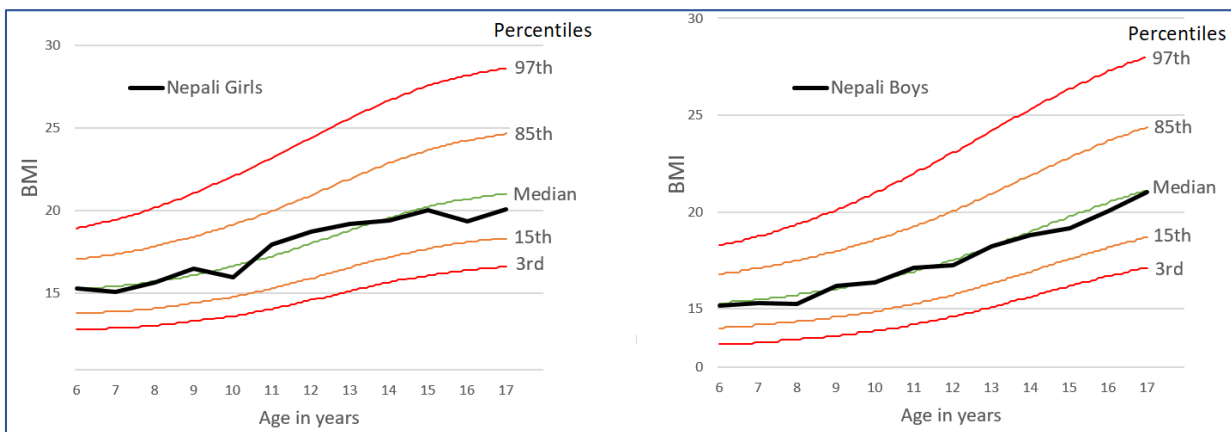


Figure 3. Mean BMI of Nepali boys/girls against WHO reference data

Table 1. Mean and Standard deviation of different anthropometrics in Nepali students as per their age

Age (yrs)	Boys				Girls			
	N	Height (cm)	Weight (kg)	BMI (kg m ⁻²)	N	Height (cm)	Weight (kg)	BMI (kg m ⁻²)
6	28	107.43±7.93	17.51±2.27	15.16±1.29	28	111.30±7.33	19.13±4.30	15.27±1.92
7	18	121.44±4.77	22.61±2.77	15.30±1.54	16	116.80±5.93	20.69±3.09	15.09±1.56
8	30	124.17±6.78	23.07±3.25	15.26±1.53	21	123.24±7.63	24.04±5.94	15.66±2.60
9	43	125.43±7.22	25.75±5.45	16.20±2.26	29	129.14±9.53	28.11±8.71	16.49±2.88
10	39	128.52±6.14	27.16±6.05	16.37±3.24	36	131.09±6.30	27.62±5.28	15.93±1.96
11	57	136.22±5.94	31.94±6.26	17.11±2.58	39	134.07±22.29	33.73±7.62	17.94±4.18
12	55	139.94±9.38	33.93±7.37	17.26±3.4	37	144.89±9.44	39.64±10.31	18.71±3.26
13	81	151.19±11.79	41.79±8.59	18.23±2.98	87	148.91±6.90	42.86 ±9.74	19.19±3.46
14	141	156.45±9.20	46.36±9.28	18.80±2.86	104	156.45±9.20	45.17 ±7.49	19.39±3.16
15	82	159.25±6.93	48.85±8.63	19.19±2.85	90	153.59±7.86	47.01 ± 6.71	20.00 ±3.17
16	35	158.10±7.42	50.42±8.70	20.06±2.64	30	152.14±10.46	44.96 ± 8.21	19.35±2.98
17	18	158.32±7.53	52.86±9.89	21.03±3.41	16	153.70±6.88	47.48 ± 7.76	20.07±2.72

Values are means &SD.

Table 2. Height for age of Nepali school children as per the WHO percentile category

Height for age 6 to 17 years						
	Severely stunted (%)	Stunted (%)	Normal height (%)	>97 th percentile (%)	Total	
Boys	86 (13.7%)	94 (15%)	443 (70.7%)	4 (0.6%)	627 (100%)	
Girls	62 (11.6%)	63 (11.8%)	400 (75%)	8 (1.5%)	533 (100%)	
Total	148 (12.8%)	157 (13.5%)	843 (72.67%)	12 (1.03%)	1160 (100%)	
Weight for age 6 to 10 years						
	Severely Underweight	underweight	Normal weight	> 97 th percentile	Total	
Boys	22 (13.9%)	16 (10.1%)	120 (76%)	0	158 (100%)	
Girls	20 (15.4%)	13 (10%)	91 (70%)	6 (4.6%)	130 (100%)	
Total	42 (14.58%)	29 (10.08%)	211 (73.26%)	6 (2.08%)	288 (100%)	
BMI for age 6 to 17 years						
	Severely thin (%)	Thin (%)	Normal BMI (%)	Overweight (%)	Obese (%)	Total (%)
Boys	35 (5.6%)	22 (3.5%)	492 (78.5%)	55 (8.8%)	23 (3.7%)	627 (100%)
Girls	23 (4.3%)	19 (3.6%)	424 (79.5%)	49 (9.2%)	18 (3.4%)	533 (100%)
Total	58 (5.02%)	41 (3.53%)	916 (78.96%)	104 (8.96%)	41 (3.53%)	1160 (100%)

Table 3. Association between father's occupation and mean BMI and Height of school's children

Father's occupation	N	Mean BMI	Leven's test	Anova	p	Effect size η^2	Mean height	Leven's test	Welch Anova	p	Effect size η^2
Service/Job	539	18.32±3.2	F=1.42	F=5.4		0.01	147.57±13.99	F=13.28			0.06
Business	111	18.54±2.9	P=0.24		0.05		145.72±16.99	P=0.00	F=34.56	0.00	
Labor/farmer	375	17.36±6.9					138.70±17.05				

Table 4. Association between various other characteristics and mean BMI and height of school children

Characteristics	N	Mean BMI	Leven's test	t-test	p-value	Mean height	Leven's test	t-test	p-value
Illiterate father	193	16.92±2.8	F=0.633,			134.44±17.7	F=23.35		
Literate father	777	18.49±3.2	p=0.427	T=6.05	0.00	147.54±14.29	P=0.00	T=9.53	0.00
Housewife	574	18.04±6.0	F=1.7			143.68±16.42	F=11.73		
Working Mother	231	18.32±3.2	P=0.192	T=-0.66	0.50	147.87±13.85	P=0.001	T=-3.68	0.00
Government school	603	17.31±8.8	F=3.64			141.55±17.26	F=22.56		
Private school	555	18.42±3.2	P=0.05	T=2.86	0.004	146.68±14.33	P=0.00	T=-5.50	0.00
<3 siblings	973	17.82±7.3	F=0.793			144.17±16.25	F=0.66		
>3 siblings	114	17.54±2.9	P=0.373	T=0.40	0.684	139.92±16.41	P=0.41	T=2.64	0.008

The proportion of severely thin and thin were high among boys than girls. The proportion of boys, who were thin and severely thin, were slightly high compared to girls. Whereas, the proportion of overweight and obesity among the boys and girls were found to be somewhat similar, Table 2.

Bivariate analysis showed factors like father's literacy and occupation, mother's literacy and occupation, school type, having a greater

number of siblings were statistically associated (significant) with BMI and the Height.

BMI and Father's occupation- The descriptive statistics associated with BMI level across three occupational groups (service/job, business and labor), Table 3, labor/farmer was associated with numerically smallest mean level of BMI (17.36±6.9) and the students with

father's occupation as business was associated with the numerically highest mean level of BMI (18.54±). Prior to conduction ANOVA, homogeneity of variance was determined based on Levene's test, $F(2, 1022) = 1.426, p = 0.241$, which was not significant. Hence, the homogeneity of variance was assumed. There was a statistically significant difference between groups as determined by one-way ANOVA ($F(2, 1022) = 5.406, p = .005$). A Tukey post hoc test revealed that the mean BMI was statistically significantly lower for the students who have fathers working as labor with largest standard deviation (17.36±6.9) in comparison to who have fathers doing business (18.54±2.9, $p = 0.068$) and students who have fathers doing service/job (18.38±3.2, $p = 0.00$). However, the effect size as estimated by Eta-squared is only $\eta^2 = 0.01$, which is very small. Only 1% of the total variance is accounted for by the father occupation.

Height and Father's occupation- The descriptive statistics associated with height across three occupational groups (service/job, business and labor/farmer), Table 3, shows father's occupation having labor group was associated with numerically smallest mean height (138.70) and the students with father occupation as office worker was associated with the numerically highest mean height (147.57). Prior to conduction ANOVA, homogeneity of variance was determined based on Levene's test, $F(2, 1021) = 13.28, p = 0.00$, which is highly significant. Hence, the homogeneity of variance was not assumed. The test of choice was Welch's ANOVA. There was a statistically significant difference between groups as determined Welch's ANOVA ($F(2, 290.05) = 34.564, p = 0.00$). A Games-Howell post hoc test revealed that the mean height was statistically significantly lower for the students who have fathers working as labor (138.70±17.05) in compare to who have fathers doing business (145.72±16.99, $p = 0.01$) and students who have fathers doing service/job (147.57±13.99 $p = 0.00$). However, the effect size as estimated by Eta-squared is only η^2

=0.06, which is very small. Only 6% of the total variance is accounted for by the father occupation.

Similarly, statistically significant association between various other characteristics and mean BMI and mean height, Table 4, show Father's education and the school type to be statistically significant with mean BMI and the height. Mother's occupation and number of siblings were found to be significantly associated with the mean height only. The students with illiterate father and studying in government school have statistically significant smaller mean BMI and height in compare to others. The students with mother's occupation being house wife and having >3 siblings have statistically significantly smaller mean height in compare to others. The difference in mean BMI and mean height between boys and girls were not found to be significantly associated.

Discussion

In this study, the nutritional assessment of Nepali school children and adolescents assessed by mean weight for age, height for age and BMI for age, were at 3rd and 15th percentile for both boys and girls, 15th percentile for boys and between 3rd and 15th percentile for girls and 50th percentile for boys and between 15th and 50th percentile for girls respectively, are quite comparable with the findings in the study carried out in schools from Kathmandu valley in the year 2007.¹⁰ With the growth curve for weight for age and BMI for age (only in case of boys) are slightly better than in compare to the above mentioned study. Because of the paucity of similar types of estimates in the past studies, it is hardly possible to comment on the prevailing trend, if any, existed in the past. Nevertheless, the nutritional status of Nepali students in this study as assessed by growth curve for height for age revealed: stunting is still an important public health problem, which is one of the important measures of chronic undernutrition. And Nepal is among the ten countries in the world with highest prevalence of stunting.¹¹

Stunting (44.5%) and underweight (49%) found in the study carried out in the year 2007 in the Kathmandu valley¹⁰ were quite high in compare to our study while the proportion of severely underweight children (7.04%) is quite low in compare to this study. More number of boys in comparison to girls were severely underweight and severely stunted. The number of stunted and underweight, in this study, were quite similar to that of estimates reported in Nepal demographic health survey (NDHS) 2016.⁶ One of the community based study carried out in Lalitpur district, in 2017, estimated the prevalence of stunting and overweight in children at 10% and 8.3% respectively.¹² These estimates are lower compared to our study. This, perhaps, is because the above-mentioned study was carried out in the children from single village not representing the diverse population coming from different economic and social background as in this study. The issue of malnutrition, though decreasing, is still a major public health problem in countries like Nepal. Which is further confirmed by the result of this study.

The issue of overweight and obesity, on the other hand, is becoming common phenomenon in every type of society today, mostly because of the change in our lifestyle.⁵ Urbanization is one that force which is driving these changes in the society. Nepal is a good example of urbanization, overweight and obese.¹³ One of the good way of looking at general adiposity is to estimate BMI of the individuals. On the scale of BMI values, it can further be categorized as severely thin, thin, overweight, and the obese. The number of students, in this study, who were thin (thin and severely thin) and overweight (overweight and obese) were almost equally distributed across the groups and across the gender, with the proportion of overweight students being slightly high in both cases.

The nationally representative data from eight Demographic and Health Surveys conducted in Bangladesh, Nepal and India, which examined the change in the prevalence rates of overweight-obesity and underweight over

the period of 10 years (from 1996 to 2006) among women aged 15-49 years, showed that the prevalence of overweight- obesity increased substantially in all three countries- in Nepal from 1.6% to 10%; in Bangladesh 2.7% to 8.9%; and in India from 10.6% to 14.8%.¹⁴ Despite of the dissimilarity in the age group of these two population, it can be clearly witnessed that the overweight-obesity rate is increasing in many parts of the world.

At the same time, there was substantial decrease in prevalence of underweight in Bangladesh, with only marginal decrease in Nepal and India. Which is the further confirmation of co-existence of, malnutrition and overweight, in a developing country like Nepal.

Furthermore, the results of recent studies carried out in different parts of Nepal looking for prevalence of overweight and obesity in adults and the children; like in Kathmandu district, in 2011, in adult women- overweight 24% and obesity 1.8%;¹⁵ in Kaski district, in 2013, among the school students- overweight 5.8% and obesity 2.3%;¹⁶ in Lalitpur sub-metropolitan city, in 2014, among the school students- overweight 12.2%,⁷ signify the similarities in the proportion of overweight and obesity in different set-ups with this study. With the exception of the prevalence of obesity in women in Kathmandu district, which is quite high. As per the world data atlas, female obesity prevalence in Nepal was 5.3% in 2016. From 1997 to 2013, female obesity prevalence grew gradually from 1.8% to it reached 10% in 2000 then decreased to 5.8% in 2016.¹⁷ In this study, too, the prevalence of overweight in the students was 8.96%, which not so much of difference with the t4g5szhyworld data atlas estimate.

This study data suggests that those students whose father were labor, fathers with illiterate educational status, housewife mothers, studying in governmental schools, having number of siblings more than three were associated with statistically significant small mean BMI and height compared to other students. Which signify the fact that the parent's income, knowledge and

understanding of the matter play a very important role in the upbringing of the children.

The present study showed that the students studying in governmental schools were more likely to have smaller height and BMI in compare to the students studying in private school, which is comparable with the findings of studies carried out in Kathmandu⁷ and in India.¹⁸ Where students studying in private schools and who were from higher socioeconomic echelon were found to be overweight and obese. The high body weight among the students could be a result of high calorie intake associated with sedentary lifestyle, which on the other hand can be because of their parents' affordability. But in the study carried out in Saudi Arab¹⁹, USA²⁰ and Switzerland²¹ the association was found to be otherwise. This may be because of the lack of comparability of these study population with the present study.

For that matter, this can't be denied that the overweight and obesity is apparently becoming new parameter for measuring level of poverty in developed and, perhaps, in developing countries too. Obesity is becoming frequent problem, not only in high income countries, but also in low and middle income countries, like Nepal.

Parents' education and occupation have an impact on nutritional status of children. In our study it has been found to be directly associated with father's education; and both parent's occupation. Better is the occupation and education level, higher tends to be the BMI. Contrary to the finding in the study carried out in Saudi Arab¹⁹ where inverse relationship between father's education and level of BMI was noticed. Our study didn't find any association between mother's education and the level of BMI. The study carried out in Switzerland²¹ also didn't find any association between mother's education and level of BMI. In the study carried out in Kaski district¹⁶, too, they didn't find any association with parent's occupation and education.

Overweight and obesity is becoming new norm in children of school going age group. Including children of both developed and developing countries, and malnutrition continue to pose a significant public health threat in this age group, in many countries, especially in developing countries, like Nepal.

Conclusion

The present study reveals that the high proportion of stunting and undernutrition still exist in Nepali school children and proportion of children with overweight and obesity is also seen. The nutritional status is similar in both the boys and girls. The role of the parent's education and occupation is significantly associated with the nutritional status of children.

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Conflict of Interest

None

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None

Author Contribution:

MM: concept, design, data collection analysis and interpretation, writing of article; LSA: concept, design, critical revision of the article, final approval of article; PK concept, data collection analysis and interpretation. All authors read and approved final draft.

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Supplement

Questionnaire

Date:

Department of Community Medicine
 Manipal College of Medical Sciences
 School Health Program

Name of School:

Class:

DETAILS OF STUDENT

Name:

Date of birth/age:

Sex:

Number of siblings:

Religion:

Name of guardian: Hindu Buddhist Muslim Other

Relationship of guardian: Father Mother Other

Known Medical problem: Yes No

Known psychological/behavioral problem:

Family details

Living parents: Both One None

Father: Present Away Deserted Dead

Occupation:

Education: Illiterate Undergraduate Graduate

Mother: Present Away Deserted Dead

Occupation:

Education: Illiterate Undergraduate Graduate

History of Hypertension: None Mother Father

History of Diabetes: None Mother Father

History of Physical Handicap: None Mother Father

Immunization status of child:

BCG	
OPV3	
DPT3	
Measles	
Rubella	
Japanese Encephalitis	
Others	

Others:

Physical examination:

General:

Height in (cms)	
Weight in (Kgs)	
BMI	
Pulse	
Blood pressure	

Miscellaneous: Pallor/Jaundice/Lymph nodes/Edema/Goiter/Congenital deformity/other

Skin:

Nutritional H/O Ear discharge <2wks

Scabies H/O Ear discharge >2wks

Pediculosis Deafness/Hearing impairment

Patch Sore throat

Impaired sensation other

Avitaminosis

Eyes:

Vit A
 Nightblindness conjunctival Xerosis
 Bitot's spots Corneal Xerosis
 Right
 Keratomalacia Other
 Right
Vit B Complex: Stomatitis
 Other

Complaints:
 Wears Glasses
 Distant Vision Left
 Near Vision Left
 Color Vision Squint

Dental
 8 7 6 5 4 3 2 1 8 7 6 5 4 3 2 1 **Dental Points:**
 8 7 6 5 4 3 2 1 8 7 6 5 4 3 2 1
 Caries tooth Gingival disease
 Other
 Advised: Oral prophylaxis/Extraction/Restoration/RPD/FPD/RCT/Orthodontic treatment

Cardiovascular	Respiration	Abdomen	Genito urinary	CNS	Musculo-skeletal
Heart Vascular Other	ARI Suspect TB Other	H/O worms in stool Liver/Spleen Other	Specially undescended testis in Male	Convulsion Epilepsy Other	Polio Congenital anomaly Other

Provisional diagnosis:

Advised:
 Treatment
 Referred to:
 Remarks:

Signature of medical officer/Faculty in Charge