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Association Between Socio-Demographic Variables and Body Mass Index (BMI) among School-Going Adolescents: A Cross-Sectional Study in Pokhara

Santosh Kafle[1], Yadu Ram Upreti[2*]; Prakash Sharma[3]; Mahesh Pokhrel[4]
[1] Tribhuvan University, Central Department of Education, Kirtipur, Kathmandu, kafles517@gmail.com
ORCID: https://orcid.org/0009-0006-6227-4105
[2] Tribhuvan University, Central Department of Education, Kirtipur, Kathmandu; yaduram.upreti@tucded.edu.np ORCID: https://orcid.org/0000-0002-2705-1209
[3] Tribhuvan University, Butwal Multiple Campus, Butwal; prakasharma35@gmail.com
ORCID: https://orcid.org/0000-0002-7197-4502
[4] Tribhuvan University, Graduate School of Education, Kirtipur, Kathmandu; maheshpokhrel61@gmail.com
ORCID: https://orcid.org/0009-0002-4624-3457
***Corresponding Author:** yaduram.upreti@tucded.edu.np

Keywords

Body Mass Index (BMI), Physical Activity, Adolescents, Socioeconomic Status, Pokhara, School Health

Abstract

The nutritional status of school adolescents is a determining factor that influences their present and future health, cognitive development, and academic success. This paper investigates the relationship between socio-demographic characteristics and nutritional status, as measured by body mass index (BMI), among school-going adolescents in Pokhara, Gandaki Province, Nepal. Using a cross-sectional survey research design, data were collected from 384 students aged 10 to 19 years. The sample included an equal number of male and female adolescents, with 54% from community schools and 46% from institutional schools. The study employed a structured self-administered questionnaire with closed-ended questions and anthropometric measurements, including height and weight. Descriptive statistics (i.e., central tendency and standard deviation) and bi-variate analysis (i.e., chi-square test) were utilized. The findings reveal that students' age, grade, and fathers' occupation were significantly associated with nutritional status (BMI) at $p < 0.05$ among adolescents. Results indicate that younger adolescents from community schools, aged 10-14 years, and those whose fathers were employed, are more likely to experience malnutrition, including both undernutrition and overnutrition. The study emphasizes the close relationship between socio-demographic variables (such as age group, grade, and parents' occupation) and the nutritional status of school-going adolescents. It recommends school-based health promotion programs integrated with family environments to encourage healthy dietary behaviors and improve nutrition status.

Introduction

The nutritional status of school-aged children and adolescents in Nepal constitutes a significant public health concern (Acharya et al., 2024; Upreti et al., 2024). Demographic factors such as type of school, age group, ethnicity, and parents' education and occupation among individuals aged 5 to 19 years are crucial for shaping the nation's future development (Choedon et al., 2024). In Nepal, schools are broadly classified into two types: community (public) and institutional (private). This distinction significantly impacts educational resources, parental involvement, and students' health behaviors (Ministry of Education, 2020). However, many within this group face nutritional challenges that can negatively impact their physical growth, cognitive development, and academic performance (Acharya et al., 2024). The prevalence of stunting in Nepal, among children under five, was reported at 25%, reflecting a declining trend. Nonetheless, older children are also impacted due to the cumulative effects of early-life undernutrition. Furthermore, thinness remains a prevalent issue among adolescents, particularly in rural areas and among females (Ministry of Health and Population [Nepal], New ERA, & ICF, 2023).

Adolescence (ages 10 to 19) is a period of rapid growth, necessitating adequate nutrition and health surveillance (UNICEF, 2023). The nutritional status of adolescents is a crucial determinant of their current and future health, cognitive development, and academic performance (WHO, 2021). Body Mass Index (BMI), a widely utilized indicator for assessing nutritional status, reflects whether adolescents are underweight, normal weight, or overweight/obese based on their weight in relation to height (CDC, 2022). The World Health Organization highlights the increasing burden of malnutrition in this age group, ranging from undernutrition, such as thinness and stunting, to overnutrition, including overweight and obesity (WHO, 2022). The recent national demographic health survey has indicated a rising prevalence of both forms of malnutrition in Nepal (Ministry of Health and Population, New ERA, & ICF, 2023).

While some adolescents experience inadequate caloric intake and poor dietary diversity, others are increasingly exposed to energy-dense but nutrient-poor diets, particularly in semi/urban areas in Nepal (Upreti et al., 2020). Socio-demographic characteristics such as parental education, occupation, household income, and school type (community vs. institutional) significantly influence nutritional status among adolescents (Acharya et al., 2024). Similar findings were observed among the higher education students, where socio-demographic factors such as sex, subject specialization, and caste/ethnicity were significantly associated with junk food consumption (Pokhrel et al., 2024). Research suggests that adolescents from families with lower educational and economic backgrounds are more likely to experience undernutrition, whereas those from higher socioeconomic strata increasingly face challenges related to overweight and obesity (Hamann et al., 2023). School nutrition programs, such as the national mid-day meal program in Nepal, have also been found to have a positive effect on improving the nutritional status, attendance, and equity of students, even though quality and implementation issues are present (Pokhrel et al., 2025).

Geographical variation also plays a critical role in shaping adolescent health outcomes. For instance, regions such as Pokhara report high rates of underweight-related malnutrition (up to 39%) among adolescents, while urban areas like Bhaktapur exhibit rising obesity rates (up to 12%), suggesting a double burden of malnutrition that mirrors Nepal's

broader socioeconomic divide (Adhikari et al., 2016; Sainju et al., 2016). Adolescents' body composition and metabolic health are profoundly affected by dietary practices and socio-demographic factors (Upreti et al., 2021). Available literature reveals that most studies are either focused on public schools or in private ones. Given the context, the present study focuses on assessing how socio-demographic variables are associated with the nutritional status of both public and private schools' adolescents. While previous studies have explored the nutritional status among adolescents within either private or public schools, none of them has comparatively evaluated the two environments and presented a knowledge gap on how the type of school interacts with other socio-demographic determinants (Upreti et al., 2024).

Methods

Study Design

A quantitative cross-sectional descriptive survey research design was utilized to assess how socio-demographic variables are associated with the nutritional status of school-going adolescents.

Study Population and Sample

This study was conducted in Pokhara Metropolitan, located in the Kaski District, which was selected due to its convenient accessibility to the researcher (first author), substantial student population, and availability of the community and institutional schools. This area is particularly suitable for investigating nutritional status as it reflects socioeconomic diversity and urban lifestyle changes. Additionally, it was a practical and manageable choice for the researcher in terms of time, resources, and institutional collaboration.

Students were selected by proportionate stratified random sampling to ensure representation from both community and institutional schools. Classes were then selected randomly in the chosen schools, and students were sampled randomly proportionate to the size of the class. This ensured representation of the types of school, grade, and sex distribution. The study population comprised of school students aged 10 to 19 years, enrolled in grades 5 to 12. The selected ward encompasses ten schools, including three community and seven institutional schools. According to the Integrated Educational Management Information System (IEMIS) records, Ward No. 1 had a total of 3,328 students across both community and institutional schools. Both institutional and community schools were selected purposely to represent the heterogeneity of the respondents, as nutritional status is also reported to differ by school type because of socio-economic reasons

The sample size of the respondents was determined using the Rao soft online calculator (http://www.raosoft.com/samplesize.html), which is designed to calculate the necessary sample size for population surveys with a 5% margin of error. Based on the population size of 3,328, and to achieve a 95% confidence level with a 5% margin of error, the Rao soft calculator indicated a minimum sample size of 345. However, data were collected from 384 students due to practical considerations at the field level (Table 1).

Table 1.

Study Population and Sample Size

S.N.	Schools	Student Population (N)	Sample Size (n)
1	Community school	1221	208 (54.2%)
2	Institutional school	240	176 (45.8%)
	Total	1461	384 (100%)

In several classes within the selected schools, two to four students were unavailable for participation during data collection. To maintain representativeness and balance across the selected institutions, the researcher (first author) opted to include additional participants from other available students.

Data Collection Tool

A self-administered structured questionnaire served as the data collection tool, which comprised two main sections: the first gathered socio-demographic information, and the second covered BMI. Participants' body weight was assessed using a reliable calibrated digital weighing scale with proper instructions to the students regarding removal of the heavy clothing and shoes, and standing position, keeping both legs at a V-shape for accurate measurement. The weight was measured in kilograms (Kg). Height was measured using a standardized measuring tape affixed to a wall, ensuring that students maintained an upright posture with their head aligned in the Frankfort plane. The height was measured in meters (M). The first author, along with trained research assistants, was involved in height and weight measurements. Research assistants were involved in the orientation session before they were involved in the data collection process. School teachers facilitated the process by maintaining order and assisting with logistical arrangements, but they did not participate in the measurement process to ensure precision. Each measurement of height and weight was conducted twice to ensure consistency.

Before the questionnaire was employed among students, a pre-test with 30 participants (approximately 10% of the sample size) was conducted to assess internal consistency using Cronbach's alpha. The pre-test was administered in a school, which was not included in the main study sample, to avoid recall bias. Revisions were made based on the feedback and outcomes of the pre-test to enhance clarity and reliability. The data were collected in August 2024.

Data Analysis

After the collection of data, they were verified, coded, and subsequently entered into the Statistical Package for Social Sciences (SPSS version 25). This software facilitated the data analysis process, which included data cleaning, rechecking, verifying and ensuring validation and reliability. Then, the computation of summary statistics such as frequency, percentage, mean, and standard deviation for each variable. Additionally, tables (simple, custom, and cross) were utilized to present the data. To compare and interpret the data, a chi-square test was employed. The chi-square test was specifically applied to ascertain the association between socio-demographic information and nutritional status, and significance was assessed at the $p < 0.05$ level. To obtain BMI for children aged 10–19 years, we measured students' weight and height accurately. BMI was calculated using the formula: BMI= weight (kg) / height in meter square (Acharya & Nakanishi, 2021).

Ethical Consideration

This study followed ethical standards to ensure the confidentiality of all students participating in this study. Before data collection, written and verbal informed consent was obtained from the school administration and parents of participating students, and informed assent was ensured from the students. Participants were assured that the study would not take any risk after taking part in the study; instead, they would receive their height and weight measurements. All students were informed of their right to withdraw from the study at any point without any pressure. Confidentiality and anonymity were maintained, and all data were secured and used for the academic purposes of the study.

Results

This section presents the findings of the study under three subsections: socio-demographic profile (Table 2), BMI status (Table 3), and the association between socio-demographic profile and BMI status of the respondents (Table 4).

Socio-Demographical Profile

The demographic details of the respondents, including age, sex, grade, religion, caste, parents' educational status, and the main source of income for the household, are presented in Table 2.

Table 2.

Socio-Demographic Description of the Respondents *(n = 384)*

Description	Response	Frequencies (N)	Percentage (%)
Type of School	Community	208	54.2
	Institutional	176	45.8
Sex	Male	192	50
	Female	192	50
Age group	10-14 Years	184	47.9
	15-19 Years	200	52.1
Level of Study/ Grade	Basic School (1-8)	190	49.5
	Secondary School (9-12)	194	50.5
Religion	Hindu	290	75.5
	Boudha	41	10.7
	Islam	2	0.5
	Christian	51	13.3
Caste	Brahmin/Chhetri	140	36.5
	Adhibasi/Janajati	177	46.1
	Dalit	61	15.9
	Madhesi and Muslim	6	1.5
Father's Educational Status	Cannot Read and Write	2	0.5
	Just Read and write	242	63.0
	School Education	109	28.4
	Higher Education	31	8.1
Mother's Educational Status	Cannot Read and Write	16	4.2
	Just Read and Write	245	63.8
	School Education	103	26.8
	Higher Education	20	5.2
Father's Occupation	Agriculture and	57	14.8
	Unemployment	97	25.3
	Business	230	57.9
	Employed		
Mother's Occupation	Housemaid and Agriculture	241	62.8
	Business	81	21.1
	Employed	62	16.1
Number of Siblings	No Siblings	231	60.2
	Having up to 2 Siblings	149	38.8
	Having up Up-to 4 Siblings	4	1

Table 2 demonstrates that more than half of the respondents (54%) were from community schools, while the rest were from institutional schools. Among respondents, 47.9% were aged 10–14 years and 52.1% were aged 15–19 years. Three-fourths (76%) of them were Hindu, followed by Christian, Buddhist, and Islam. Nearly half of them (46%) were *Adhibasi/Janajati*, followed by Brahmin/ Chhetri (37%), Dalit (15.9 %), and Madhesi and Muslim (1.5 %). Regarding educational status, nearly two-thirds of both fathers and mothers (63% vs 63.8%) were just literate. More than three-fifths (62.8%) of the mothers were housemaids and agricultural workers, whereas three-fifths of fathers (59.9%) were employed. Nearly two-thirds (60%) of them had no siblings, while 39% had two, and the least of them also (1%) had up to four siblings.

BMI Status

Nutrition status of students was obtained by Body mass index (BMI). The BMI was calculated by dividing weight in kg by height in meter square (BMI=kg/m^2). The obtained value ranges from 18.5 to 24.99 were considered as normal nutrition status, and both below and over the ranges were considered as under-nutrition and over-nutrition status (Table 3).

Table 3.

BMI Status of School-Going Adolescents

Nutrition Status	Frequency	Percentage (%)
Under-nutrition and over-nutrition	181	47.2
Normal	203	52.9
Total	384	100

Table 3 demonstrates the BMI status of the respondents. The results reveal that more than half (52.9%) of them exhibited a normal BMI, referring to the normal nutrition status, i.e. a healthy weight range according to their weight and height. In contrast, 47.1% were found to be either under-nutrition or over-nutrition, indicating a double burden of malnutrition encompassing both underweight and overweight conditions.

Association Between Socio-Demographic Variables and BMI Status

The results present the distribution of malnutrition across various socio-demographic groups. Malnutrition prevalence was higher among students from community schools (51%) compared to those from institutional schools (42.6%), although the difference was not statistically significant. Similarly, no significant differences were observed between male and female students and between Hindu and non-Hindu students (Table 4).

Table 4.
Association between Socio-Demographic and BMI Status

Socio-Demographic Information		BMI Status		
Variables	**Categories**	**Undernutrition and Over Nutrition Status (%)**	**Normal Nutrition Status (%)**	**P-Value**
Type of School	Community	51.0	49.0	0.103
	Institution	42.6	57.4	
Sex	Male	49.5	50.5	0.358
	Female	44.8	55.2	
Age Group	10-14 Years	56.5	43.5	0.001***
	15-19 Years	38.5	61.5	
Caste	Brahmin/Chhetri	52.9	47.1	0.186
	Adhibasi/Janajati	45.2	54.8	
	Dalit, Madeshi and Muslim	40.3	59.7	
Religion	Hindu	46.2	53.8	0.372
	Non-Hindu	52.9	47.1	
Level/Grades	Basic School	54.2	45.8	0.006**
	Secondary School	40.2	59.8	
Father's Occupation	Agriculture and	33.3	66.7	0.048*
	Unemployment	45.4	54.6	
	Business	51.3	48.7	
	Employed			
Mother's Occupation	Housemaid and Agriculture	43.2	56.8	0.092*
	Business	56.8	43.2	
	Employed	50	50	
No. of Siblings	No Siblings	49.4	50.6	0.422
	Having up to 2 Siblings	43.3	55.7	
	Having up to 4 Siblings	25.0	75.0	

Note. Significant at *p=<0.05, **p=<0.01and**p=<0.001

Table 4 reveals a statistical relationship between the socio-demographic information of students and their BMI status. The table shows that a statistically significant association was found between level/grade and nutrition status, with basic-level students exhibiting a higher prevalence (54.2%) of malnutrition than the secondary-level (40.2%). Additionally, students whose fathers were employed were either undernutrition or overnutrition (51.3%), whereas those whose fathers were engaged in agriculture or unemployed had a low prevalence of malnutrition condition (33.3%). This difference was also observed as statistically significant. In contrast, although students whose mothers were engaged in business had the highest malnutrition prevalence (56.8%)

compared to those whose mothers worked in agriculture or as domestic workers (43.2%), this difference was not statistically significant. Age was significantly associated with poor nutrition status, with the highest prevalence observed among students aged 10–14 years (56.5 %) and aged 15-19 years (38.5 %) ($p = 0.001$). Although *Brahmin/Chhetri* students exhibited a higher condition of poor nutrition status (52.9%) than *Adhibasi/Janajati* (45.2%) and *Dalit/Madhesi/Muslim* students (40.3%), these differences were not statistically significant. Surprisingly, a decreasing trend in malnutrition was noted with an increasing number of siblings. But this difference was not statistically significant.

Discussion

The results of the study reveal that there was a balanced gender distribution, with respondents drawn almost equally from both basic and secondary school levels. The majority of them were *Hindu* with a prominent existence of socioeconomically varied caste and ethnic groups. The majority of the respondents' parents had received formal education, and a significant portion of fathers were engaged in employment, while mothers were primarily involved in household responsibilities. Nearly half of them had poor nutritional status, highlighting the existence of overnutrition and undernutrition. Bivariate analysis revealed that age, grade/level, and father's occupation were found to be significant socio-demographic factors associated with the BMI of students.

Age is found to be a significant determinant to influence nutritional status, as younger adolescents were found to be more victims of malnutrition. This observation is consistent with Senbanjo and Oshikoya (2010), who found that undernutrition was more prevalent among younger children, even though they were engaged in physical activities. Similarly, early adolescents, who undergo the physiological demands of rapid growth and pubertal transition during which half of their bone mass is formed, require evidently increased macronutrient and micronutrient intake to support linear growth and bone accretion; failure to meet these requirements renders them especially vulnerable to undernutrition (Moore-Heslin et al., 2023; Soliman et al., 2022).

Students from the basic level were found to exhibit poor nutritional outcomes compared to secondary level students. In consistency with this finding, a longitudinal study in China found that younger students experienced higher rates of undernutrition and overnutrition compared to their upper-grades (Liu et al. 2024). Further, Liu et al. 2025 also focused on similar arguments in a cross-sectional study in China that primary-grade children frequently exhibited less nutritional knowledge and practiced unhealthy dietary behaviors in relation to students in later grades.

Students with fathers engaged in employment exhibited poorer nutritional status than those whose fathers worked in agriculture or remained unemployed. Similar to the finding, a study conducted among preschool children in Rupandehi district also found that parents' income is significantly associated with children's nutrition status (Sharma et al., 2022). Similarly, Sainju et al. (2016) observed that 12% of adolescents in Bhaktapur were found to be overweight due to sedentary lifestyles, indicating regional variations in Nepal's nutritional trends. Likewise, larger families and low income have a detrimental impact on the nutritional outcomes of children because the limited household resources are distributed more widely (Downey, 2001; Hamann et al., 2023; Acharya et al., 2024). Another study conducted in Brazilian children (Rossi et al. 2018) found that

children from low-income families living near parks had lower BMI. It can be argued that the lack of time for parental supervision and time to prepare homemade food there to greater dependency on convenience foods; as a result, adolescents are facing nutritional problems (Braune et al. 2024).

This study provides valuable insights into the nutritional status of adolescents in Pokhara by examining the relationship between socio-demographic factors and BMI using a representative sample from both community and institutional schools. The reliability of the data is enhanced by using standardized anthropometric measurements. However, as a cross-sectional study, it cannot establish the causality of this condition, highlighting the need for future longitudinal and intervention-based research. Reliance on self-reported socio-demographic data may introduce bias, and the exclusive use of BMI limits the assessment of overall nutritional status. Additionally, the geographical scope of the study was limited to a single ward of Pokhara metropolitan city, which may affect the generalizability of the results.

Conclusion

This study aimed to assess the association between socio-demographic variables and nutritional status, based on BMI, among school-going adolescents in Pokhara. The results of the study suggest that the prevalence of under-nutrition surpasses that of over-nutrition, particularly among students attending community schools, those in younger age groups (10-14 years), and individuals from lower socioeconomic backgrounds. Further, the results of the study suggest that demographic variables such as age, grade/level of study, and parental occupation are significantly associated with the nutritional status of students. The findings underscore the need for school-based nutrition interventions, particularly among younger adolescents in the community schools that address broader socio-economic determinants of adolescent health and also help to achieve Nepal's commitments to Sustainable Development Goal 3. Future research could consider a longitudinal study design and broader geographic coverage with comprehensive dietary assessments and qualitative observations to capture the socio-cultural and economic dynamics of adolescents' nutrition in Nepal.

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Author's Contribution

The article has been derived from the first author's master's thesis submitted to the Health and Population Education Department, Central Department of Education, TU in May 2025. Hence, SK utilized his thesis data to develop this paper. YRU, his thesis supervisor, constantly offered him critical feedback along with rigorous edits on the draft until the finalization of the manuscript. PS and MP, as critical colleagues, reviewed and edited the manuscript with assisting in the statistical analysis of the data. After reading the final draft of the paper, each author gave their consent for the authorship and publication.

Declaration of Conflicting Interests

None.

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