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Benchmarking the Determinants of Nutritional Status among Community Schools' Children in Nepal

DEVARAJ ACHARYA[1], KRISHNA BAHADUR THAPA[2], TULSI RAM BHANDARI[3], SURENDRA GIRI[1], YADU RAM UPRETI[4]*, BHIMSEN DEVKOTA[5], SUSHIL SHARMA BHATTARAI[6] and KRISHNA PRASAD TRIPATHI[6]

[1]Research Centre for Educational Innovation and Development [CERID], Tribhubvan University, Kathmandu.
[2]Sanothimi Campus, Tribhuvan University, Bhaktapur
[3]Pokhara University, Pokhara.
[4]Central Department of Education, Tribhuvan University, Kathmandu.
[5]Mahendra Ratna Campus Tahachal, Tribhuvan University, Kathmandu, Bournemouth University, UK.
[6]Prithvi Narayan Campus, Tribhuvan University, Pokhara.

Abstract

The government of Nepal initiated the Mid Day Meal Program (MDMP) to reduce hunger and increase educational outcomes, including health status. However, limited studies have been conducted on these issues covering the nutritional status of students at the lower basic level at community schools in Nepal. The main objective of the study is to determine the factors associated with malnutrition among children from community schools in Nepal. A school-based cross-sectional study was conducted in 98 (46 basic and 52 secondary) community schools from 44 municipalities in Nepal. Altogether, 2727 students participated in the questionnaire survey and anthropometric measurement. Data collection was performed on May 10-31, 2023. WHO Anthro plus and LMS (Lambda Mu and Sigma) parameters were used: weight for age for national health and nutrition survey recommended by CDC/National Center for Health Statistics for ages older than ten years to analyze nutritional status, including z scores. Descriptive analysis, including inferential analyses such as the chi-square test and logistic regression, was performed using IBM SPSS Statistics v25. The prevalence of weight-for-age Z-score[WAZ], height-for-age Z-score [HAZ], and body mass index-for-age Z-score [BAZ] were 72%, 75%, and 82%, respectively. Students with z-scores outside the range of ±2 were classified as malnourished. Of them, 27.3%, 23% and 16.6% were assessed

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CONTACT Yadu Ram Upreti yaduram.upreti@tucded.edu.np Central Department of Education, Tribhuvan University, Kathmandu.

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as underweight, stunted and thin, respectively. Students' sociodemographic characteristics such as age, sex, family size and type, source of income, wealth status were significantly associated with malnutrition, while age group, sex, wealth status, residence setting, and geographical location were noted as significant predictors of nutritional status. The study found no statistical relationship between school feeding and good nutrition, questioning the quality of the midday meal program. The study concludes that existing school-based nutritional interventions need to be re-evaluated and re-designed since it is less potent to minimize malnutrition among students substantially. Policymakers could consider these findings when planning and implementing nutrition-related policies and programs.

Introduction

Nutritional status is one of the major indicators of health, wealth and development as well. Good nutrition is required for physical growth, cognitive and mental development, health, and well-being.[1] It represents several indicators and aspects such as health, economic, socio-demographic, and growth and development and determines future life among school-age children. School-age children go through a journey of rapid physical growth and cognitive development.[2] The Constitution of Nepal (CoN) 2015 has declared that food sovereignty is one of the citizen's fundamental rights and that the state is responsible for ensuring it.[3] However, recent national health surveys of Nepal show that more than one-third of children under five years of age are suffering from malnutrition,[4] and almost the same scenario persists in other age groups.

Inadequate nutrition claims the lives of one-third of children globally, accounting for 2.6 million deaths.[5] The latest United Nations report shows that 10% of the world's population suffers from hunger, and one in three people have regular access to adequate food. In central and southern Asia, 29.8% and 13.6% of children are stunted and wasted, respectively, and the COVID-19 pandemic has worsened the situation.[6] The Global Hunger Index 2023 report revealed that one in three people worldwide has insufficient calories, resulting in undernourishment. One in six children is stunted, which means low height-for-age, resulting from chronic undernutrition. A proportion of these children also have low weight-for-height, known as wasted, caused by acute undernutrition.[7] Malnutrition poses a severe public health threat to Nepalese children.[8,9] Malnutrition among young children in Nepal is considered a complex issue by the National Planning Commission/ Second Multi-sectoral Nutritional Plan (NPC/MSNP, 2018-2022). The 15th development plan, ZERO HUNGER, Sustainable Development Goals (SDGs), economic growth, employment promotion, poverty alleviation, post-conflict reconstruction, social transformation, and human resource development are the government's development priorities, which are also clearly outlined in the framework of the CoN 2015.[3] These high-priority categories are closely related to the nutritional status of the people.

The school lunch program was first started in France in 1885, and since then it has been gradually introduced in various countries: the US (1946), UK (1945), Japan (1947), China (1964-69), Australia (1950), Switzerland (1946), Singapore (1975), Indonesia (1967), Thailand (1970), Korea (1973), and India (1995).[10] Similarly, the Government of Nepal (GoN) has initiated a midday meal program for all students in lower basic community schools throughout Nepal since 2020.[11] The recent studies provide strong evidence of the positive impact of school feeding programs on children's nutritional status and overall well-being, reinforcing the importance of such initiatives in promoting health and education in low-income and food-insecure regions.[12,13]

A study conducted in a landlocked country in southern Africa, which shares similar geopolitical and socio-economic conditions with Nepal, demonstrated a complex malnutrition landscape. Despite a more significant proportion of learners having adequate nutrition knowledge and exhibiting healthy eating practices, overweight was the leading form of malnutrition, coexisting with stunting and wasting.

Although evidence is limited regarding the current state of knowledge about the nutritional status of school-age children in Nepal, national policies and programs such as the National School Health Nutrition Strategy, Multi-Sectoral Nutrition Plans, and the School Education Sector Plan aim to improve the nutritional status of school children through nutrition education.

Most previous studies have focused on children under five years of age or teenagers, but the middle age group needs to be addressed. However, all age groups, especially children aged 6-12, are equally important as other life stages. The previous studies have laid the gap in nationally representative data on the nutritional status of school-aged children and their associated factors in Nepal. Additionally, national benchmarks still need to be created for those who study at the primary school level, particularly in lower basic schools. Given the gap, the present study aimed to determine the nutritional status and their underlying co-variates of socio-demographic determinants among community school children in Nepal.

Materials and Methods

Study Design

The study used a quantitative observational cross-sectional survey design.[14] Data was collected retrospectively to assess the nutritional status of students who completed the 5th grade and enrolled in schools.

Population and Study Setting

The study's population included all students who completed the 5th grade (completed lower basic) and enrolled in the 6th grade in community schools in 2023. The study was conducted in selected community schools from different districts covering all geographic areas, including rural/urban areas and both primary/secondary schools in various provinces.

Study Size

The sample size was determined using the following formula.[15]

$$n = [DEFF * Np(1-p)] / [(d^2 / Z^2\_1-\alpha/2 * (N-1)) + p(1-p)]$$

Where:

The 'n' represents the sample size, and 'N' denotes the population size (for the finite population correction factor or FPC). The total number of students enrolled in grade five was 455,409, but according to the Flash I Report 2078 Field,[16] 134,471 students were enrolled in grade five in the study area. The 'p' signifies the hypothesized percentage frequency of the outcome factor in the population (p), estimated at 50% +/- 5. Similarly, the 'd' indicates the confidence limits as a percentage of 100 (absolute +/- %), set at 5%. DEFF stands for the design effect, which was assigned a value of 2. Initial calculations yielded a sample size of 767. Subsequently, this value was adjusted for three eco-belts multiplied by three and an assumed 90% response rate, resulting in a final sample size of 2556. Therefore, the study proceeded with a sample size 2556 to ensure adequate statistical power and precision in the findings.

Sampling Techniques

A multi-stage sampling design was employed to select students for the survey. We first selected all provinces and then randomly selected three districts from the Mountain, Hill, and Inner-terai/Terai regions as applicable and one district from the Kathmandu valley. Then, we selected two municipalities at the local level that covered both urban and rural areas. Similarly, we randomly assigned each local municipality's primary and secondary schools. Therefore, there were 88 schools in 22 urban and 22 rural municipalities and 46 basic and 52 secondary schools in 22 districts. The sample was distributed by probability proportional to size (PPS) using the Flash Report by the Centre for Education and Human Resource Development.[16] At the school level, we took all students who completed the fifth grade and enrolled in the sixth grade as a sample. In case the targeted sample was lacking, a proximal school was visited. Therefore, the sample exceeded the target by 107%, representing 2,727 students from 46 basic and 52 secondary schools. There was no non-response since there was a mandatory provision in the KoBoTool box for proceeding with the online application form. Field enumerators were experienced in rapport building and data collection. During data collection, no one refused to participate; therefore, all the respondents/participants participated in nutritional measurement and other responses.

Inclusion and Exclusion Criteria

The students who came under the sampling frame wanted to participate, provided assent/consent, completed 5th grade and, enrolled in 6th grade, and consumed the midday meal. As per the ethical norms of research, the students who did not want to participate in the anthropometric assessment were excluded from the study. Similarly, the students who completed their 5th grade from institutional (private) school, were sick during data collection, failed the final exam of 6th grade, were unavailable during data collection, or did not consume the midday meal in school were excluded.

Research Tools and Instruments

The research tools and instruments used in the study included a survey questionnaire, a digital weighing scale, and a stadiometer. The questionnaire was validated through the test-retest method, which also involved Delphi techniques. Additionally, the instruments were calibrated using a reference from the Nepal Bureau of Standards and Metrology [MCC:102/1036/1085, CCLMI: 172/1037/1100].

Data Collection

Though all the field enumerators were experienced enough, we conducted a three-day orientation program for field enumerators along with the team leader and supervisor to ensure data quality and exact information. Moreover, a day pre-test program was conducted in real field situations in three different schools. Ten geographic clusters were created for data collection. According to the sample size, each group had two to four field researchers and a team leader. An online survey tool called KoBoTool box was used to collect the data. Day-to-day monitoring was conducted to ensure the data standard and quality. Data collection was started on May 10, 2023, and was completed on May 31, 2023. All the data were kept confidential and were only handled by the KoBoTool expert and principal investigator. After completion of the data collection, it was only handled by the principal investigator to ensure the quality and confidentiality of the issues.

Variables Consideration

Socio-demographic variables such as age, sex, caste, parents' education and occupation, family size and type, wealth status, and residence setting were the independent variables. At the same time, weight-for-age, height-for-age, and body mass index-for-age were considered as dependent variables. Age, family number, and educational status were recorded for better understanding.

Data Analysis and Statistical Methods

WHO Anthro Plus v1.0.4 was used to calculate weight-for-age, height-for-age, and body mass index-for-age z scores.[17] For the calculation of weight-for-age and individuals above ten years of age, LMS (Lambda Mu and Sigma) parameters were used for girls/boys: weight for age; National Health and Nutrition Examination Survey (NHANES) by the CDC/National Center for Health Statistics.[18,19] Descriptive analysis, such as frequencies and percentages, was performed as a univariate analysis. The chi-square test measured the association as a bivariate analysis to assess the association between the variables. If there was an association between independent and dependent variables and it was statistically significant, then logistic regression was performed as a multivariate analysis.[20] Before performing the logistic regression, the variables were assessed to determine whether there was an issue of multicollinearity.[21] We found that there was no issue of multicollinearity. All these statistical analyses were performed using IBM SPSS Statistics version 25.[22]

Ethical Consideration

All administrative procedures were followed—national ethical guidelines.[23] , and ethical compliance checklists[24] were followed throughout the research process. Written consent/assent was obtained from participants and guardians. No personal identity was disclosed in the study to ensure participant confidentiality, and participants were informed that their data would be securely used solely for the study.

Results

This section presents an analysis of the nutritional assessment and explores the association between general characteristics and nutritional status of students.

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Univariate Analysis

Of the 2,727 participants, the majority were from Madhesh province, accounting for 28.2%, followed by Bagmati province (14.7%) and Karnali province (13.4%). More than half (51.3%) of the participants were from urban municipalities. More than two-thirds (69.5%) of them studied in secondary schools, almost three-fourths (74.9%) were more than 11 years old, and 24.5% of the participants were 11 years old and below. Similarly, the majority (53.6%) were girls and 28.9% were from Adibasi/Janajati. More than half of the participants had a family of up to five members, and more than two-thirds (69.2%) were from a nuclear family. Almost one-fourth of the participants stated that their family's main income was labor, and 86.4% lived in their homes. Nearly all (90.6%) participants had eaten mid-day meals during school hours, and 59.4% brought money to school. Only eight percent of the fathers and 19% of the students' mothers reported they could not read and write (illiterate). Most of the parents were involved in the informal sector, including labor. More than half (56%) of the participants belonged to a poor wealth status, followed by the middle (27%) and rich (17%). Most of the participants (51.6%) were from the Terai eco-belt, followed by the Hill (34.7%) and the Mountain (13.6%).

Of the total participants, 28%, 24.8% and 18.2% had non-normal weight-for-age z scores [WAZ], low/high height-for-age z scores [HAZ], and low/high body mass index [BMI]-for-age z scores [BAZ] respectively, accounting for below and above ±2 sigma. In this study, z scores within ±2 sigma of WAZ, HAZ, and BAZ are considered normal nutritional status. In contrast, z scores outside of (more than) ±2 sigma of WAZ, HAZ, and BAZ are considered abnormal or indicative of malnutrition. Less than -2 sigma z scores of WAZ, HAZ, and BAZ are considered undernutrition, referred to as underweight, stunted, and thinness, which represent 27.5%, 23%, and 16.6%, respectively (Table 1).

Table 1: Background characteristics and nutritional status of the students

Variables	Categories	Total	
		N	%
Province	Koshi	315	11.6
	Madhesh	770	28.2
	Bagmati	402	14.7
	Gandaki	213	7.8
	Lumbini	359	13.2
	Karnali	365	13.4
	Sudurpashchim	303	11.1
Type of Municipality	Rural Municipality	1329	48.7
	Urban Municipality	1398	51.3
Type of School	Basic [up to 8]	832	30.5
	Secondary [up to 10/12]	1895	69.5
Age of the students	Up to 10 Years	289	10.6
	Eleven years	669	24.5
	Twelve to sixteen years	1769	64.9
Sex	Girls	1462	53.6
	Boys	1265	46.4
Caste/Ethnicity	Dalit	627	23.0
	Adibasi/Janajati	789	28.9
	Madhesi	486	17.8
	Brahmin/Chhetri	719	26.4
	Muslim/Others	106	3.9

Family Size	Up to 5 Members	1375	50.4
	6 to 10 Members	1193	43.7
	More than 10 Members	159	5.8
Type of Family	Nuclear	1886	69.2
	Joint/Extended	841	30.8
Home Status	Own	2355	86.4
	Rented/Others	372	13.6
Type of Home	Mud Build (Conventional)	919	33.7
	Semi-concrete	838	30.7
	Concrete	970	35.6
Main Source of Income	Agriculture	636	23.3
	Business	361	13.2
	Service	381	14.0
	Labour	692	25.4
	Foreign Job	604	22.1
	Others	53	1.9
Taken Midday Meal at school	Yes	2471	90.6
	Yes, Some times	104	3.8
	No	152	5.6
Sufficiency of Midday Meal	Insufficient	400	17.3
	Sufficient	1918	82.7
Bring Money from Home for School Meal	No	1106	40.6
	Yes	1621	59.4
Education	Unable to read/write	218	8.0
	Literate (Read and write)	842	30.9
	School Education	1612	59.1
	Higher Education	55	2.0
Mother Education	Unable to read andwrite	527	19.3
	Literate (Read and write)	1094	40.1
	School Education	1090	40.0
	Higher Education	16	.6
Father Occupation	Agriculture	615	22.6
	Service	339	12.4
	Business	364	13.3
	Foreign Job	575	21.1
	Labour and Others	834	30.6
Mother Occupation	Agriculture	764	28.0
	Service	124	4.5
	Business	177	6.5
	Foreign Job	66	2.4
	Labour and Others	1596	58.5
Wealth Quintiles	Poorest	346	12.7
	Poor	1182	43.3
	Middle	737	27.0
	Rich	365	13.4
	Richest	97	3.6
Ecological Region	Mountain	372	13.6
	Hill	947	34.7
	Terai	1408	51.6
WAZ Score	Within ± 2 sigma	1964	72.0

	Below and above ± 2 sigma	763	28.0
HAZ Score	Within ± 2 sigma	2051	75.2
	Below and above ± 2 sigma	676	24.8
BAZ Score	Within ± 2 sigma	2231	81.8
	Below and above ± 2 sigma	496	18.2
WAZ Score < −2 sigma [Underweight]	No	1976	72.5
	Yes	751	27.5
HAZ Score < −2 sigma [Stunted]	No	2101	77.0
	Yes	626	23.0
BAZ Score < −2 sigma [Thinness]	No	2274	83.4
	Yes	453	16.6
Total		**2727**	**100.0**

Bivariate Analysis

The highest proportion (38.1%) of underweight students was observed in Madhesh province, followed by Lumbini (29.8%) and Sudurpashchim (23.4%). The same scenario persists for thinness, which accounts for 30% of total participants from Madhesh, followed by Sudurpashchim (19.8%) and Koshi, Lumbini, and Karnali province (10%, p=<0.001). More than one-third (36.2%) of the participants from Lumbini province observed a low height for age (stunted) compared to Madhesh (26.4%) and Bagmati (23.6%) (p=<0.001). The students in rural areas were more vulnerable to malnutrition than those in urban areas (p=<0.001). The older the participants, the higher the proportion of malnutrition in all three forms (p=<0.001). Interestingly, boys were more vulnerable to malnutrition than their counterparts (p=0.01) [Table 2].

The proportion of wasted, stunted, and thinness was found among participants of Muslim and other castes, which accounted for 36.8%, 27.4%, and 28.3%, respectively (p=0.003). The size of the participants' families was significantly associated with undernutrition. The larger the family size (more than ten members), the higher the underweight and thinness, which accounted for 33.3% and 20.8%, respectively, compared to those households that had less than ten family members (p=<0.001). The same results were observed for joint families, which had a higher proportion of malnutrition, mainly in the underweight, stunted, and thinness rates, compared to nuclear families. Interestingly, participants who lived in their own homes noticed a higher prevalence of undernutrition compared to those who lived in rented/other homes (p=0.010), and participants who had temporary or mud-built homes appeared to have all three types of undernutrition compared to those who had a concrete or semi-concrete house (p=<0.001). The WAZ and BAZ scores (less than -2 σ) were higher among the participants who had agriculture as the primary source of household income, while the BAZ score was noticed to be higher in labor as the primary source of income (p=0.009) [Table 2].

Surprisingly, the participants who had taken mid-day meals at school had a higher proportion of underweight, stunted, and thinness rates than those who had not taken day meals at school and the sufficiency of food available during day meals. Mother's education was significantly associated with malnutrition in children. The higher the mother's education, the lower the malnutrition rate (p=<0.021). Wealth status is significantly related to nutritional status. The poorest participants had a higher proportion of malnutrition rates than the wealthiest participants (p=<0.001). In the case of eco-belts, the highest proportion of wasted, thinness, and malnutrition appeared in terai areas, while the most stunted were found in mountain areas (p=<0.001) [Table 2].

Table 2: Association of background characteristics and weight for age[WAZ], height for age[HAZ], and BMI for age [BAZ]

Variables	Categories	Underweight [WAZ]				ρ value	Stunted [HAZ]				ρ value	Thinness [BAZ]				ρ value	Total
		No		Yes			No		Yes			No		Yes			
		N	%	N	%		N	%	N	%		N	%	N	%		N
Province	Koshi	251	79.7	64	20.3	<0.001	258	81.9	57	18.1	<0.001	283	89.8	32	10.2	<0.001	315
	Madhesh	477	61.9	293	38.1		567	73.6	203	26.4		539	70.0	231	30.0		770
	Bagmati	315	78.4	87	21.6		307	76.4	95	23.6		366	91.0	36	9.0		402
	Gandaki	167	78.4	46	21.6		173	81.2	40	18.8		193	90.6	20	9.4		213
	Lumbini	252	70.2	107	29.8		229	63.8	130	36.2		322	89.7	37	10.3		359
	Karnali	282	77.3	83	22.7		297	81.4	68	18.6		328	89.9	37	10.1		365
	Sudurpashchim	232	76.6	71	23.4		270	89.1	33	10.9		243	80.2	60	19.8		303
Type of Municipality	Rural	897	67.5	432	32.5	<0.001	961	72.3	368	27.7	<0.001	1074	80.8	255	19.2	<0.001	1329
	Urban	1079	77.2	319	22.8		1140	81.5	258	18.5		1200	85.8	198	14.2		1398
Type of School	Basic	569	68.4	263	31.6	0.002	626	75.2	206	24.8	0.138	690	82.9	142	17.1	0.672	832
	Secondary	1407	74.2	488	25.8		1475	77.8	420	22.2		1584	83.6	311	16.4		1895
Age of the students	Upto to 10 years	269	93.1	20	6.9	<0.001	268	92.7	21	7.3	<0.001	270	93.4	19	6.6	<0.001	289
	11 years	537	80.3	132	19.7		596	89.1	73	10.9		587	87.7	82	12.3		669
	12 to 16 years	1170	66.1	599	33.9		1237	69.9	532	30.1		1417	80.1	352	19.9		1769
Sex	Female	1107	75.7	355	24.3	<0.001	1126	77.0	336	23.0	0.972	1244	85.1	218	14.9	0.010	1462
	Male	869	68.7	396	31.3		975	77.1	290	22.9		1030	81.4	235	18.6		1265
Caste, Ethnicity	Dalit	441	70.3	186	29.7	<0.001	491	78.3	136	21.7	0.037	504	80.4	123	19.6	<0.001	627
	Adibasi/Janajati	607	76.9	182	23.1		590	74.8	199	25.2		713	90.4	76	9.6		789
	Madhesi	315	64.8	171	35.2		364	74.9	122	25.1		352	72.4	134	27.6		486
	Brahmin/Chhetri	546	75.9	173	24.1		579	80.5	140	19.5		629	87.5	90	12.5		719
	Muslim/Others	67	63.2	39	36.8		77	72.6	29	27.4		76	71.7	30	28.3		106
Family Size	Upto 5 Members	1042	75.8	333	24.2	0.001	1070	77.8	305	22.2	0.625	1189	86.5	186	13.5	<0.001	1375
	6 to 10 Members	828	69.4	365	30.6		910	76.3	283	23.7		959	80.4	234	19.6		1193

	> 10 Members	106	66.7	53	33.3		121	76.1	38	23.9		126	79.2	33	20.8		159
Type of Family	Nuclear	1391	73.8	495	26.2	0.024	1463	77.6	423	22.4	0.327	1607	85.2	279	14.8	<0.001	1886
	Joint/Extended	585	69.6	256	30.4		638	75.9	203	24.1		667	79.3	174	20.7		841
Home Status	Own	1668	70.8	687	29.2	<.001	1795	76.2	560	23.8	0.010	1941	82.4	414	17.6	0.001	2355
	Rented/Others	308	82.8	64	17.2		306	82.3	66	17.7		333	89.5	39	10.5		372
Type of Home	Mud Build	615	66.9	304	33.1	<.001	672	73.1	247	26.9	<0.001	715	77.8	204	22.2	<0.001	919
	Semi-concrete	613	73.2	225	26.8		636	75.9	202	24.1		716	85.4	122	14.6		838
	Concrete	748	77.1	222	22.9		793	81.8	177	18.2		843	86.9	127	13.1		970
Main Source of Income	Agriculture	434	68.2	202	31.8	.001	471	74.1	165	25.9	0.009	528	83.0	108	17.0	0.006	636
	Business	277	76.7	84	23.3		295	81.7	66	18.3		305	84.5	56	15.5		361
	Service	302	79.3	79	20.7		310	81.4	71	18.6		343	90.0	38	10.0		381
	Labour	493	71.2	199	28.8		519	75.0	173	25.0		562	81.2	130	18.8		692
	Foreign Job	428	70.9	176	29.1		461	76.3	143	23.7		493	81.6	111	18.4		604
	Others	42	79.2	11	20.8		45	84.9	8	15.1		43	81.1	10	18.9		53
Taken Daymeal	Yes	1770	71.6	701	28.4	.008	1885	76.3	586	23.7	0.013	2045	82.8	426	17.2	0.022	2471
	Yes, Some times	81	77.9	23	22.1		89	85.6	15	14.4		92	88.5	12	11.5		104
	No	125	82.2	27	17.8		127	83.6	25	16.4		137	90.1	15	9.9		152
Sufficiency of Meal	Insufficient	303	75.8	97	24.3	.013	308	77.0	92	23.0	0.691	345	86.3	55	13.8	0.016	400
	Sufficient	1333	69.5	585	30.5		1459	76.1	459	23.9		1557	81.2	361	18.8		1918
Bring money from home	No	773	69.9	333	30.1	.013	838	75.8	268	24.2	0.191	919	83.1	187	16.9	0.731	1106
	Yes	1203	74.2	418	25.8		1263	77.9	358	22.1		1355	83.6	266	16.4		1621
Father Education	Unable to read/write	161	73.9	57	26.1	.405	167	76.6	51	23.4	0.204	188	86.2	30	13.8	0.236	218
	Literate	597	70.9	245	29.1		636	75.5	206	24.5		693	82.3	149	17.7		842
	School Education	1174	72.8	438	27.2		1250	77.5	362	22.5		1343	83.3	269	16.7		1612
	Higher Education	44	80.0	11	20.0		48	87.3	7	12.7		50	90.9	5	9.1		55
Mother	Unable to	369	70.0	158	30.0	.001	404	76.7	123	23.3	0.021	427	81.0	100	19.0	0.001	

527																
Education	read/write															
	Literate	761	69.6	333	30.4		814	74.4	280	25.6		886	81.0	208	19.0		1094
	School Education	831	76.2	259	23.8		869	79.7	221	20.3		946	86.8	144	13.2		1090
	Higher Education	15	93.8	1	6.3		14	87.5	2	12.5		15	93.8	1	6.3		16
Father Occupation	Agriculture	423	68.8	192	31.2	0.005	453	73.7	162	26.3	0.046	511	83.1	104	16.9	0.009	615
	Service	269	79.4	70	20.6		270	79.6	69	20.4		305	90.0	34	10.0		339
	Business	275	75.5	89	24.5		297	81.6	67	18.4		305	83.8	59	16.2		364
	Foreign Job	407	70.8	168	29.2		439	76.3	136	23.7		474	82.4	101	17.6		575
	Labour and Others	602	72.2	232	27.8		642	77.0	192	23.0		679	81.4	155	18.6		834
Mother Occupation	Agriculture	545	71.3	219	28.7	0.128	589	77.1	175	22.9	0.438	639	83.6	125	16.4	0.206	764
	Service	101	81.5	23	18.5		102	82.3	22	17.7		112	90.3	12	9.7		124
	Business	130	73.4	47	26.6		135	76.3	42	23.7		151	85.3	26	14.7		177
	Foreign Job	52	78.8	14	21.2		55	83.3	11	16.7		56	84.8	10	15.2		66
	Labour and Others	1148	71.9	448	28.1		1220	76.4	376	23.6		1316	82.5	280	17.5		1596
Wealth Quintiles	Poorest	223	64.5	123	35.5	<0.001	233	67.3	113	32.7	<0.001	270	78.0	76	22.0	<0.001	346
	Poor	821	69.5	361	30.5		890	75.3	292	24.7		962	81.4	220	18.6		1182
	Middle	552	74.9	185	25.1		584	79.2	153	20.8		630	85.5	107	14.5		737
	Rich	295	80.8	70	19.2		308	84.4	57	15.6		322	88.2	43	11.8		365
	Richest	85	87.6	12	12.4		86	88.7	11	11.3		90	92.8	7	7.2		97
Ecological Belts	Mountain	272	73.1	100	26.9	<0.001	268	72.0	104	28.0	<0.001	338	90.9	34	9.1	<0.001	372
	Hill	745	78.7	202	21.3		768	81.1	179	18.9		843	89.0	104	11.0		947
	Terai	959	68.1	449	31.9		1065	75.6	343	24.4		1093	77.6	315	22.4		1408
Total		**1976**	**72.5**	**751**	**27.5**		**2101**	**77.0**	**626**	**23.0**		**2274**	**83.4**	**453**	**16.6**		**2727**

Table 3: Logistic regression on background characteristics and weight for age, height for age and BMI for age

Variables	Categories	Underweight			Stunted			Thinness		
		AOR	95% CI		AOR	95% CI		AOR	95% CI	
			Lower	Upper		Lower	Upper		Lower	Upper
Province	Koshi	Ref.			Ref.			Ref.		
	Madhesh	2.010	1.324	3.052	1.585	1.050	2.394	2.139	1.285	3.561
	Bagmati	0.892	0.554	1.435	1.231	0.780	1.942	0.602	0.316	1.148
	Gandaki	1.194	0.734	1.943	0.965	0.594	1.568	0.870	0.455	1.663
	Lumbini	1.321	0.842	2.072	2.063	1.376	3.094	0.779	0.430	1.408
	Karnali	0.647	0.395	1.062	0.762	0.473	1.229	0.740	0.390	1.406
	Sudurpashchim	0.795	0.506	1.249	0.377	0.226	0.631	1.464	0.850	2.521
Type of Residing Municipality	Rural	Ref.			Ref.			Ref.		
	Urban	0.750	0.601	0.935	0.581	0.470	0.718	0.896	0.690	1.163
Type of School	Basic	Ref.								
	Secondary	0.683	0.550	0.848						
Age of the students	Up to 10 years	Ref.			Ref.			Ref.		
	11 years	4.170	2.476	7.023	1.826	1.090	3.059	2.520	1.445	4.394
	12 to 16 years	8.655	5.291	14.158	6.653	4.162	10.635	4.203	2.517	7.017
Sex	Female	Ref.						Ref.		
	Male	1.524	1.254	1.852				1.352	1.075	1.701
Caste, Ethnicity	Dalit	Ref.			Ref.			Ref.		
	Adibasi/Janajati	0.861	0.642	1.155	1.285	0.963	1.715	0.569	0.396	0.817
	Madhesi	1.004	0.726	1.388	1.140	0.818	1.589	1.097	0.774	1.557
	Brahmin/Chhetri	1.205	0.889	1.633	1.405	1.034	1.909	0.878	0.610	1.265
	Muslim/Others	1.068	0.641	1.780	1.304	0.776	2.191	1.159	0.671	2.001

Family Size	Up to 5 Members	Ref.						Ref.			
	6 to 10 Members	1.329	1.050	1.683				1.167	0.883	1.542	
	> 10 Members	1.361	0.854	2.168				1.062	0.625	1.805	
Type of Family	Nuclear	Ref.						Ref.			
	Joint/Extended	0.939	0.731	1.206				1.210	0.906	1.615	
Home Status	Own	Ref.			Ref.			Ref.			
	Rented/Others	0.637	0.446	0.912	0.960	0.693	1.331	0.730	0.467	1.142	
Type of Home	Mud Build	Ref.			Ref.			Ref.			
	Semi-concrete	0.985	0.764	1.271	1.220	0.947	1.572	0.858	0.636	1.157	
	Concrete	0.939	0.715	1.235	0.881	0.666	1.166	0.742	0.537	1.026	
Main Source of Income	Agriculture	Ref.			Ref.			Ref.			
	Business	0.709	0.365	1.377	0.987	0.507	1.921	0.618	0.284	1.345	
	Service	0.711	0.393	1.287	0.878	0.492	1.569	0.488	0.226	1.055	
	Labour	0.790	0.472	1.322	1.510	0.905	2.517	0.688	0.370	1.281	
	Foreign Job	0.969	0.512	1.835	1.240	0.652	2.359	1.344	0.625	2.886	
	Others	0.819	0.341	1.963	1.091	0.432	2.758	0.727	0.269	1.969	
Sufficiency of Meal	Insufficient	Ref.						Ref.			
	Sufficient	1.028	0.768	1.374				1.073	0.749	1.537	
Bring money from home	No	Ref.						Ref.			
	Yes	0.917	0.745	1.129				1.111	0.870	1.419	
Mother Education	Unable to read/write	Ref.			Ref.			Ref.			
	Literate	1.155	0.882	1.511	1.017	0.776	1.334	1.308	0.957	1.789	
	School Education	1.130	0.852	1.500	1.095	0.822	1.457	1.095	0.784	1.532	
	Higher Education	0.570	0.067	4.849	0.796	0.161	3.943	1.432	0.153	13419	
Father Occupation	Agriculture	Ref.			Ref.			Ref.			
	Service	1.007	0.546	1.857	1.154	0.641	2.078	1.113	0.505	2.455	

	Business	1.053	0.547	2.028	0.748	0.385	1.453	1.172	0.544	2.523
	Foreign Job	0.969	0.505	1.859	0.866	0.452	1.659	0.655	0.298	1.441
	Labour and Others	1.103	0.669	1.818	0.703	0.428	1.156	1.330	0.725	2.437
Wealth Quintiles	Poorest	Ref.			Ref.			Ref.		
	Poor	0.965	0.712	1.307	0.889	0.658	1.201	0.969	0.687	1.367
	Middle	0.773	0.540	1.107	0.694	0.487	0.988	0.820	0.540	1.246
	Rich	0.625	0.396	0.987	0.572	0.365	0.894	0.909	0.531	1.558
	Richest	0.172	0.063	0.469	0.397	0.188	0.838	0.298	0.085	1.053
Ecological Region	Mountain	Ref.			Ref.			Ref.		
	Hill	0.838	0.593	1.185	0.563	0.404	0.783	1.545	0.951	2.512
	Terai	0.820	0.562	1.195	0.545	0.376	0.788	1.599	0.959	2.664
Constant		**0.091**	**0.123**	**0.036**						

Note: The bold face indicates that the values are statistically significant, and 'Ref.' refers to the reference category.

Multivariate Analysis

Multivariate analysis shows that although provinces, residence settings, age groups, castes, homestay status/types of homes, primary sources of income, mother's education, wealth quintiles, and eco-belts were significant variables in determining the nutritional status of school children, province and ecological belts, residence setting such as home status, age group, sex, and wealth status were significant predictors of nutritional status. The participants living in Madhesh province were noticed to be 2.01, 1.15, and 2.14 times more likely to be underweight, stunted and thin, respectively, compared to the participants who lived in the Koshi province (AOR = 2.01, 95% CI: 1.32-3.05; AOR = 1.59, 95% CI: 1.05-2.39; AOR = 2.14, 95% CI: 1.29-3.56). Participants from Terai and Hill regions observed that 45% and 44% were less likely to be stunted compared to those who lived in mountain areas (AOR = 0.55, 95%CI: 0.38-0.79; AOR = 0.56, 95%CI: 0.40-0.78). However, participants who lived in urban areas were 25% and 42% less likely to be underweight and stunted compared to those who lived in rural areas, respectively (AOR = 0.75, 95% CI: 0.60-0.94; AOR = 0.58, 95% CI: 0.47-0.72). The age of the participants was a significant predictor of malnutrition, indicating that the older the age, the higher the chances of malnutrition.

Similarly, the participants over 11 years of age were 8.66, 6.65 and 4.20 times more likely to be underweight, stunted, and thin compared to those who were less than 11 years respectively (AOR = 8.66, 95% CI: 5.29-14.16; AOR = 6.65, 95% CI: 4.16-10.64; AOR = 4.20, 95% CI: 2.52-7.02).

In the same way, boys were 1.52 and 1.35 times more likely to be underweight and thin compared to girls, respectively (AOR = 1.52, 95% CI: 1.25-1.85; AOR = 1.35, 95% CI: 1.08-1.70). Interestingly, participants who did not have their own homes or stayed in rented or other homes appeared less likely to be underweight than those who lived in their own homes (AOR = 0.64, 95% CI: 0.45-0.91). On the other hand, it was observed that participants with better socio-economic status appeared to be less likely to have malnutrition [Table 3].

Discussion

The present study found that 27.5%, 23%, and 16.6% of the school children were underweight, stunted, and thin, respectively, which was almost similar (underweight- 25.1%; stunted- 23%; thinness-12.5%) to the evidence laid by a systematic review-based study in developing countries conducted by Khan *et al*., (2022).[25] A longitudinal observational study conducted among basic-level school children in Nepal revealed that 16.7 %, 23.4 %, and 9.1% of school children were underweight, stunted, and thin, respectively,[11] which seems almost similar to the present study. A similar proportion of stunted (24.5%), underweight (14.9%), and wasted (9.7%) was observed in Kenya.[26] A school-based cross-sectional study conducted among school children aged 6–12 in Ghana also revealed that 3.8%, 10.4%, and 12.1% were underweight, stunted, and thin, respectively,[27] which seems to be slightly lower than the present study. Similarly, in Cameroon, the prevalence of stunting was 27%, wasting 23%, thinness 22% and underweight 20% among the school children who were internally displaced, which is almost similar to this study.[28]

A study in Benue State, Nigeria, showed that the proportions of stunted, underweight, and wasting were 32%, 20%, and 13 % among the school children having age 8.7±5.3 years' .[29] The magnitude of undernutrition seems to vary in time, place, and person. A review from Eastern and Southern Africa shows that the prevalence of thinness ranged from three to 36.8%, stunting from 6.6 to 57%, and underweight from 5.8 to 27.1% among school-age children and adolescents, which is almost similar to this study. Similarly, a scooping review following the evidence on the burden of malnutrition for children and adolescents aged 5–19 years in South Asia, revealed that the prevalence of thinness was 1.9 to 88.8%, wasting 3 to 48%, underweight 9.5 to 84.4%, and stunting 3.7 to 71.7% among school children and adolescent.[1] The above evidence suggest that malnutriotn in the forms of underweight, stunted and thinness remain a significant public health concern among school-going children and adolescnets of Nepal. A wide array of causes may be responsible for malnutrition, which may be low intake of foods and nutrients, communicable and non-communicable diseases, work infestation, and internal metabolic disorder. Behaviour factors and other hygience factors are also equally important for the nutritional status including good health.[5]

Socio-Demographic Characteristics and Nutritional Status

Socioeconomic status (SES) has been a key and trending parameter for understanding malnutrition.[30] The present study revealed that the age of the participants remained a significant predictor of malnutrition, indicating that participants over 11 years of age were more likely to be underweight, stunted, and thin compared to those under 11 years of age. Similarly, boys were more likely to be underweight and thin compared to girls, respectively. Interestingly, participants who did not have their own homes or stayed in rented or other types of homes appeared to be less likely to be underweight than those who lived in their own homes. Furthermore, the results revealed that participants with a better socio-economic status appeared less likely to have malnutrition.

The previous study conducted in India revealed that the prevalence of underweight, wasted, and stunted was 38%, 33% and 20 % respectively.[31] The study also found that the sex of the child, the type of family, the education, and the occupation of the parents were significantly associated with the nutritional status of the children, which is almost similar to this study. The Ghana study shows that 50% and 19% of school-age children aged 10-19 years (average 13.4) suffered from stunting and thinness, respectively. The study also observed that residence area, age, sex, and school-feeding program were associated with malnutrition and a higher proportion of stunted and thinness among school-feeding students than among non-school-feeding students.[32] Another study from Bangladesh conducted among grades 4 and 5 of age 10.83±1.03 years recorded an average weight of 32.4±7.21 kg and a height of 141.22±8.52 cm. Of them, 91.3% had an average HAZ score, and 89.1% had a WAZ score. The study further explored that socio-demographic variables (sex, family size) were associated with nutritional status.[33] The rate of undernutrition was 51% with 45% in girls and 57% in boys among school children in Pakistan[34] while in Kenya boys were more stunted compared to girls[26] which is similar to this study.

Another study from Pakistan shows that 40% of school-age children suffer from malnutrition. Among them, 35% of boys and 22.5% of girls were stunted, and 25% of boys and 17.5% of girls were underweight. The severity of malnutrition was higher in boys than in girls, which is similar to this study. Interestingly, a systematic review shows that the median wasted, stunted, and underweight rates were 11%, 51%, and 32%, respectively in Papua New Guinea.[35] Similarly, a synthesis of evidence shows that the proportion of underweight was 25.1%, stunting 23%, wasting 24%, and thinness 12.5% among children and early adolescents (5-15 years) in developing countries.[25] The evidence suggests that participants above 11 years of age, male participants, those who live in their own homes, and participants with poor socio-economic status were more likely to experience malnutrition compared to their counterpart.

Geographic Location and Nutritional Status

The study showed that variables such as geographical locations (provinces and ecological belts), residence settings (homestay status/types of home), caste, primary source of income, mother's education, and wealth quintiles were significantly associated with underweight, stunted, and thinness. However, geographical locations, residence conditions, age group, sex, and wealth status significantly influenced the nutritional status of children studying in Nepal's community schools. The geography of any nation matters in terms of nutritional status. The present study also revealed that geographical locations such as the province and the ecological belt were significant covariates of nutritional status in schoolchildren. A higher proportion of underweight and thinness was found in Madhesh province, while stunts were found in Lumbini province. It is questionable why a higher proportion of malnutrition was found among children living in Madhesh Province since it is considered fertile land for food production and storage.

The Nepal Demographic Health Survey (NDHS) 2022 showed that the rates of stunted, underweight, and thinness in Terai were 24.8%, 18.7%, and 7.7%, respectively among the children under five years of age.[4] The NDHS 2022 also showed that a higher proportion of malnutrition persisted in Madhesh Province. Children living in the Madhesh provinces appeared more vulnerable to malnutrition. Tentatively, children five or under five years old were assessed in 2016 and were more likely to be selected in this study. This means that the children who were already suffering from malnutrition are more likely to persist in malnutrition in the present situation. The study conducted in India [30] highlights the significant association between geographical location and the nutritional status of children, focusing on district-level variations in stunting, wasting, and underweight. This suggests that geographical variation plays a crucial role in determining the nutritional status of children. This evidence underscores the importance of considering place-specific factors when addressing child nutrition issues.

School Feeding and Nutritional Status

Indeed, school feeding programs play a crucial role in enhancing children's nutritional status and overall well-being.[36] The evidence strongly supports the efficacy of school feeding programs in enhancing the nutritional status of children. By addressing immediate nutritional needs and promoting long-term health and developmental benefits, these programs play a crucial role in improving the well-being of children, particularly in food-insecure and low-income regions. Although, previous studies have revealed that school feeding has a positive association with the nutritional status of school-going children,[11,13,36] the present study found that school feeding was not positively associated with good nutritional status among school children. This indicates that students who had taken midday meals at school had a higher proportion of underweight, stunting and thinness compared to those who did not have midday meals from school. Additionally, the sufficiency of food available during the midday meal was not positively associated with good nutritional status. This association was not also supported by multivariate analysis. The previous study also showed similar results with a higher prevalence of thinness among children who had a midday meal at school compared to those who did not have a school day meal.[37]

These results further explore whether the food provided to the students covers dietary diversity, adequate nutritional content, and healthy cooking and serving practices that meet their nutritional requirements. This remains a question for the mid-day meal program and requires further monitoring. It is also important that intake of food alone is not

sufficient for better nutritional status; rather, it should be safe, fresh, nutritious, and diverse in terms of ingredients and nutritive vaule.[38] The above evidence indicates that school feeding programs can have a positive impact on children's nutritional status, especially when the meals served are enriched with the necessary nutrients.

Strengths and Limitations of the Study

First, the study has covered a wide range of samples, ensuring diversity and increasing the likelihood that the results are representative of Nepal. Second, the evidence of the study is strong since three layers of statistical analyses were performed: univariate, bivariate, and multivariate. Third, the findings serve as a benchmark for policymakers to design and implement targeted nutritional interventions and policies aimed at improving the health and well-being of school-age children.

However, there are some potential limitations to consider. The study was limited by the variables included and provided only snapshots of data mining, lacking previous data from the children. The results also relied on self-reported data, which may introduce social desirability bias. Lastly, since this study was a cross-sectional observational study, it could not establish causal relationships, highlighting the need for future interventional studies.

Conclusion

The present study suggests that being underweight, stunted, and thin are common malnutrition problems among basic-level children of public schools. The socio-demographic factors such as geographic location, residence setting, age group, sex, and wealth status were noted as significant predictors of the nutritional status of school children. Unlike the previous studies results, the present study found that school feeding was not positively associated with good nutritional status among school children. The findings of the study question the quality of midday meals being served to school children to reduce persistent malnutrition among them. Existing nutritional interventions must be reevaluated and re-considered since they have yet to reduce malnutrition among school children. More attention needs to be paid to the areas where the severity persists, such as children from Madhesh province, residents in rural settings, those aged more than 10 years, boy students, and children belonging to the poorest socio-economic status. The study recommends promoting food security across its four dimensions in the local context, where severe malnutrition persits: ensuring consistent food supply through robust agriculture and supply chains (availability); facilitating economic, physical, and social access to nutritious food (access); promoting the selection of locally produced or available foods for balanced diets (utilization); and maintaining secure food access despite external challenges (stability). Although the present study has established the relationship between covariates and the nutritional status of school children, further experimental study is nevertheless essential to determine their causal relationship.

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Conflict of interest

The authors declare that no conflicts of interest exist.

Data Availability Statement

The data used in this study are available from the corresponding author upon request.

Ethics Statement

The Ethical Review Board [ERB] of Tribhuvan University reviewed and approved the study proposal on April 17, 2023 [Ref# 384-079/80: ERBTU-079-001].

Authors' Contribution

DA, TRB, KBT, and SG conceptualized the study, analyzed the data, and developed the manuscript. YRU, BD, SSB and KPT edited the manuscript rigorously with their critical feedback and inputs. All authors read and approved the final manuscript for publication and authorship.

References

1. Choedon T, Brennan E, Joe W, *et al*. Nutritional status of school-age children (5–19 years) in South Asia: A scoping review. *Matern Child Nutr.* 2024;20(2):1-14. doi:10.1111/mcn.13607
2. Upreti YR, Bastien S, Bjønness B, Devkota B. The socio-ecological model as a framework for understanding junk food consumption among schoolchildren in Nepal. *Nutr Health*. 2021;27(3):337-346. doi:10.1177/02601060211000169
3. Nepal Law Commission. The Constitution of Nepal. Published online 2015. https://www.lawcommission.gov.np/en/wp-content/uploads/2021/01/Constitution-of-Nepal.pdf
4. Ministry of Health and Population, New ERA, ICF. Nepal Demographic and Health Survey 2022.; 2023. https://www.dhsprogram.com/pubs/pdf/FR379/FR379.pdf
5. Tadesse G, Wuletaw Y, Mekete K, *et al*. Investigating the effect of a school-based WASH intervention on soil-transmitted helminth and schistosome infections and nutritional status of school children in Ethiopia: a quasi-experimental study. *Matern Child Nutr.* 2024;19(6):1-18. doi:10.1371/journal.pone.0303492
6. United Nations: Department of Economic and Social Affairs. The Sustainable Development Goals Report 2022.; 2022. https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022.pdf
7. von Grebmer K, Bernstein J, Wiemers M, *et al*. Global Hunger Index: The Power of Youth in Shaping Food Systems.; 2023. https://www.globalhungerindex.org/pdf/en/2023.pdf
8. Department of Health Services. Annual Report 2021/2022.; 2023. https://drive.google.com/file/d/1FsObwOW2a1IGz407QGZDyJuJQ6HlBnVe/view
9. Department of Health Services. Annual Report 2077/78 (2020/21).; 2022. https://dohs.gov.np/wp-content/uploads/2022/07/DoHS-Annual-Report-FY-2077-78-date-5-July-2022-2022_FINAL.pdf
10. Si AR, Sharma NK. An empirical study of the mid-day meal programme in Khurda, Orissa. *Econ Polit Wkly.* 2008;43(25):46-55. doi:10.2307/40277588
11. Upreti YR. Transforming Nutritional Behaviors in Schoolchildren Throuh a School-Based Participatory Nutrition Education Intervention. Tribhuvan University; 2024. doi: 10.13140/RG.2.2.23046.55362
12. Cohen J, Hecht A, Mcloughlin G, Turner L, Schwartz M. Food Security, and Body Mass Index : A Systematic Review. Nutrients. 2021;13(911):1-41. doi:10.3390/nu13030911
13. Wang D, Shinde S, Young T, Fawzi WW. Impacts of school feeding on educational and health outcomes of school-age children and adolescents in low- and middle-income countries: A systematic review and meta-analysis. *J Glob Health*. 2021;11:1-27. doi:10.7189/jogh.11.04051
14. Eichhorn J. Survey Research and Sampling. SAGE Publications Ltd; 2022.
15. Open Source Epidemiologic Statistics for Public Health. Sample size for a proportion or descriptive study. web page. Published 2022. Accessed July 15, 2022. http://www.openepi.com/SampleSize/SSPropor.htm
16. Centre for Education and Human Resource Development. Flash I Report 2078 (2021/22).; 2022. https://cehrd.gov.np/file_data/mediacenter_files/media_file-17-660147103.pdf
17. World Health Organization. WHO AnthroPlus for Personal Computers Manual: Software for Assessing Growth of the World's Children and Adolescents. *World Health Organization*; 2009. http://www.who.int/growthref/tools/en/
18. Medscape. Calculator: CDC weight for age percentiles for girls (2 - 20 years). LMS Parameters for Girls: Weight for Age. National health and nutrition survey (NHANES), CDC/National Center for Health Statistics. Published 2023. Accessed January 9, 2024. https://reference.medscape.com/calculator/659/cdc-weight-for-age-percentiles-for-girls-2-20-years
19. Medscape. Calculator: CDC weight for age percentiles for boys (2-20 years). LMS Parameters for Boys: Weight for

Age. National health and nutrition survey (NHANES), CDC/National Center for Health Statistics. Published 2023. Accessed January 9, 2024. https://reference.medscape.com/calculator/658/cdc-weight-for-age-percentiles-for-boys-2-20-years

20. Denis DJ. SPSS Data Analysis for Univariate, Bivariate, and Multivariate Statistics. John Wiley & Sons, Inc; 2019. doi:10.1002/9781119465775
21. Field A. Discovering Statistics Using IBM SPSS Statistics. 6th ed. Sage; 2024.
22. George D, Mallery P. IBM SPSS Statistics 25 Step by Step: A Simple Guide and Reference. 15th ed. Taylor & Francis; 2019.
23. Nepal Health Research Council [NHRC]. National ethical guidelines for health research in Nepal. Published online 2022:1-68. https://nhrc.gov.np/wp-content/uploads/2022/04/National-ethical-guidelines-October.pdf
24. American Psychological Association. Publication Manual of the American Psychological Association. 7th ed. *American Psychological Association*; 2020. https://apastyle.apa.org/products/publication-manual-7th-edition
25. Khan DSA, Das JK, Zareen S, *et al*. Nutritional status and dietary intake of school-age children and early adolescents: Systematic review in a developing country and lessons for the global perspective. *Front Nutr.* 2022;8(February):739447(1-18). doi:10.3389/fnut.2021.739447
26. Mwaniki EW, Makokha AN. Nutrition status and associated factors among children in public primary schools in Dagoretti, Nairobi, Kenya. *Afr Health Sci.* 2013;13(1):39-46. doi:10.4314/ahs.v13i1.6
27. Aboagye RG, Kugbey N, Ahinkorah BO, *et al*. Nutritional status of school children in the South Tongu District, Ghana. *PLoS One.* 2022;17(8 August):1-21. doi:10.1371/journal.pone.0269718
28. Ejoh AR, Nwachan BM, Noumo NT. An assessment of the nutritional status of internally displaced school children in the West and Littoral Regions of Cameroon. *Food Sci Nutr.* 2024;12(6):4086-4099. doi:10.1002/fsn3.4068
29. Kor E, Iorvaa T, Uever, Jonathan Ngutyo Zwawua O. Nutritional status of primary school children in Benue State, and associated sociodemographic factors. *Glob J Heal Relat Res.* 2022;4(2):77-86. http://journals.abu.edu.ng/index.php/gjhrr/article/view/110/34
30. Obaje SG, Danborno B, Akuyam SA, Timbuak JA. Anthropometric measurements as nutritional indicators and association with sociodemographic factors among the Idoma ethnic group in Nigeria. *Precis Nutr*. 2023;2(3):e00048. doi:10.1097/PN9.0000000000000048
31. Srivastava A, Mahmood SE, Srivastava PM, Shrotriya VP, Kumar B. Nutritional status of school-age children: A scenario of urban slums in India. *Arch Public Heal.* 2012;70(1):8. doi:10.1186/0778-7367-70-8
32. Appiah KP, Amos L. Nutritional status of school-age children in the Nkwanta South District - Volta Region of Ghana. *Eur Sci J*. 2014;10(30):310-327. doi:10.19044/esj.2014.v10n30p%25p
33. Rahman MM, Rashid M, Mondol LS, *et al*. Nutritional status of primary school children with mid-day meal program. In: Proceedings of the 6th International Conference on Public Health. Vol 6. ; 2020:32-36. doi:10.17501/24246735.2020.6104
34. Amuta EU, Houmsou RS. Assessment of nutritional status of school children in Markurdi, Benue State. *Pakistan J Nutr.* 2009;8(5):691-694.
35. McGlynn PJ, Renzaho AMN, Pham MD, Toole M, Fisher J, Luchters S. Critical examination of evidence for the nutritional status of children in Papua New Guinea - a systematic review. *Asia Pac J Clin Nutr.* 2018;27(1):1-18. doi:10.6133/apjcn.042017.02
36. Cohen JFW, Hecht AA, Hager ER, Turner L, Burkholder K, Schwartz MB. Strategies to improve school meal consumption: A systematic review. *Nutrients*. 2021;13(10):1-51. doi:10.3390/nu13103520
37. Kwabla MP, Gyan C, Zotor F. Nutritional status of in-school children and its associated factors in Denkyembour District, eastern region, Ghana: Comparing schools with feeding and non-school feeding policies. *Nutr J.* 2018;17(1):1-8. doi:10.1186/s12937-018-

0321-6

38. Aljerf L, Aljerf N. Food products quality and nutrition in relation to public. Balancing health and disease. *Prog Nutr.* 2023;25(1):1-10. doi:10.23751/pn.v25i1.13928