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Factors Associated with Anthropometric Status of Primary School Children in Dodoma, Tanzania

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Abstract

Background: Malnutrition in school-age children significantly affects their health, cognitive development, and educational attainment. This study aimed to assess the nutritional status of school-age children and the influence of socioeconomic, demographic, and environmental factors on their nutritional well-being. This study focused on primary focus was on primary school children in Dodoma. sought to identify children who could be at risk of malnutrition. The study intended to establish baseline data regarding the nutritional status of school children that could contribute to a comprehensive understanding of the nutritional landscape among primary school children in the region. This information could subsequently inform nutritionists and policymakers to plan interventions to improve these children's nutritional status.

Methods: A cross-sectional study involving 248 pupils was conducted in eight primary schools in Dodoma. Four schools were selected from Chamwino and Dodoma urban districts, respectively, whereby two government schools and two private schools were selected from each district. The other four schools were situated in the urban district of Dodoma, comprising two government and two private schools. The study assessed the prevalence of stunting, wasting/thinness, underweight, and overweight/obesity among primary school children. Stunting was characterized by impaired growth and development with low height for age, while underweight was defined as low weight relative to age. Wasting/thinness refers to insufficient flesh, with body weight falling below skeletal and physical standards. Overweight/obese indicates excessive fat tissue accumulation that could impact health. Data were analyzed using the WHO AnthroPlus v1.0.4 software and SPSS v26 software for Windows.

Results: Prevalence rates among the surveyed pupils were as follows: stunting (10.5%), underweight (3.6%), thinness (2.8%), and overweight/obesity (10.1%). Stunting was more prevalent in boys (13.2%) than in girls (8.2%), and it exhibited an upward trend with increasing age. The prevalence of underweight was higher in public schools (8.2%) compared to private schools (3.2%). Thinness was more common in public schools (85.7%) compared to private schools (14.3%) and was more prevalent in rural areas (57.1%) and among younger children (57.1%). Overweight/obesity was more prevalent among girls (91.0%) compared to boys (88.6%). Schools in urban areas showed a higher prevalence of overweight/obesity (90.3%) than those in rural areas (89.5%). Private schools (95.2%) had a higher prevalence of overweight/obese pupils compared to public schools (84.7%). Pupils residing in urban areas were more likely to become overweight/obese compared to their counterparts living in rural settings.

Conclusion: Significant rates of stunting, thinness, underweight, and overweight/obesity were observed among primary schoolchildren in Dodoma, Tanzania. These findings underlined the necessity to enhance nutrition interventions to improve the nutritional status of both public and private primary school pupils in Tanzania.

Keywords: Anthropometric status, Primary school children,Nutritional status, Socioeconomic factors, and Dodoma, Tanzania

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Introduction

Malnutrition encompasses insufficient or excessive nutrient intake and imbalances or impaired utilization of essential nutrients. The double burden of malnutrition encompasses both undernutrition (i.e., stunting, underweight and wasting) and overnutrition (i.e., overweight and obesity) (WHO, 2021). Malnutrition is a prevalent public health issue across the globe that is rapidly increasing in low and middle-income countries. In 2020, an estimated 149.2 million children under the age of five years suffered from stunting, while 45.4 million children experienced wasting(Khanam *et al.,* 2017). The World Health Organization reported that, in 2019, more than 38 million children under the age of five years were either obese or overweight, and it is anticipated that this number will increase to 50 million by 2025(*WHO, 2019*). In Africa, despite high levels of undernutrition, overweight and obesity rates in children are increasing. The prevalence of overweight and obesity among school-aged children (SAC) is more than 10% in many countries, such as South et al., Kenya, and Tanzania(Mekonnen *et al.,* 2018). In Tanzania, the 2019 School Malaria and Nutrition survey reported that the prevalence of stunting, thinness, overweight and obesity were 25%, 11% and 5%, respectively(John *et al.,* 2019).

Children are the backbone of society, and their health status serves as a foundation for the health of the entire society. Research has demonstrated that growth delays among school-aged children can impede their learning, cognitive development, and academic progress(Mohammadi *et al.,* 2022). Undernutrition remains a major contributor to disease susceptibility, morbidity, and mortality among school-aged children, especially in resource-constrained countries. This issue is responsible for about half of all deaths in this population globally(Assemie *et al.,* 2020). Like under-five children, school-aged children are considered one of the most susceptible groups to undernutrition in Sub-Saharan Africa (Appleby *et al.,* 2019).

Urban children are highly susceptible to growth and nutritional deficiencies due to various factors, such as overcrowding, inadequate sanitation, unclean drinking water supply in residential areas, and other conditions that are often associated with lower socioeconomic status(Amare *et al.,* 2020; Mohammadi *et al.*, 2022). Parental education is a crucial proxy indicator of socioeconomic status, with a lack of proper hygiene and poor food habits being other reasons for nutritional deficiencies directly linked to parental education (Alderman & Haeday, 2017). In urban areas, poor eating habits, lack of dietary diversity, and excessive consumption of energy-dense, nutrient-poor junk foods and sweetened beverages contribute to overnutrition among children(Bhattacharyya *et al.,* 2021).

The malnutrition problem of school-age children is of foremost importance to all nations as this group forms future generations (Yeasmin & Islam, 2016). The existence of a triple burden of malnutrition among school-aged children and adolescents in Tanzania poses a growing health challenge. The prevalence of undernutrition in different studies conducted in India was 49% underweight and 51% stunted. In Kenya, it was 47.1%; in Ghana, 33%; and in Ethiopia, 48.5%. According to previous studies, undernutrition is a common problem among school-aged children, especially those in public schools who are more vulnerable to undernutrition due to socioeconomic-related variations(Agbozo *et al.,* 2016; Ali *et al.,* 2022; Endris *et al.,* 2017). However, there is an increasing body of evidence that childhood obesity often persists throughout adulthood and higher possibility of lifestyle modification in children as opposed to adults, interventions aiming at modifying risk factors to prevent childhood obesity should be a top priority(Hlaing *et al.,* 2012).

This paper focuses on undernutrition and overnutrition in line with the Tanzania National Multisectoral Nutrition Action Plan which provides an important opportunity to improve the nutrition and health status among this demographic (NMNAP 2021/22-2025/26). The present study was conducted to find out the nutritional status of school children and explore socioeconomic,

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demographic, and environmental factors associated with nutritional status among primary school children so that a basis for planning strategic intervention program can be undertaken from the result of this study, which will improve their health, physical growth and development, school academic performance and progress in whole life.

Methodology

Description of Study area

This research was carried out in Dodoma and Chamwino district in Dodoma region, Tanzania. Dodoma is one of the regions with higher prevalence of undernutrition among children less than five years(*TDHS, 2022*). Dodoma is a fast-growing city with rapidly changing lifestyles, modernization and socio-economic transition with population of approximately 3,085,625 (*NBS,2022*). The two districts namely Dodoma Urban district and Chamwino Rural districts were selected purposely to allow comparison in the anthropometric status of primary schools in the two districts Chamwino districts was in rural setting while Dodoma Urban district was in urban setting.

Study design.

A cross-sectional study design was employed for this research.

Sampling Frame and eligibility criteria

The study included all children aged between 6 to 13 years studying in primary schools in the selected districts. Exclusion criteria were children with physical or mental impairments, chronic illnesses, and those enrolled in boarding schools or participating in special school programs.

Sampling techniques

A stratified sampling technique was used to acquire a total of 248 children. The main sampling unit was registered primary schools. The schools were stratified into districts based on location and were sampled separately. Through this probability sampling technique, the population of school children in each school was divided into strata based on school ownership and area of residence. A total of eight primary schools, that is four government and four private schools located in urban and rural areas, were randomly selected. Average of 31 children were selected from each of selected government and private primary schools. Approximately six to seven students were selected from each class.

Sample size.

The sample size was calculated based on (Kothari, 2004) formula:

$$n = \frac{z^2 p(1-p)}{d^2}$$

Where n = sample size, z = 1.96 for a confidence limit of 95%, p = expected prevalence of overweight and obesity (18.6%), d = degree of desired precision (in this study was 0.05) and q = 1 – p.

n = (1.96^2). 0.186. (1- 0. 186)/ (0.05^2)

By using the formula and assuming an expected prevalence rate of 18.6% for overweight and obesity based on a previous study by(Mosha & Fungo, 2010), and a desired degree of precision of 0.05, the sample size of 248 pupils was selected. To obtain the sample, a random sampling technique using a table of random numbers was employed, and 31 children were randomly selected from each of the 8 schools.

Data collection

Construction of a Questionnaire

A questionnaire was formulated to solicit information from the participants. The questionnaire was divided into three sections. Section A established rapport with the participants, section B solicited information about socioeconomics such as the child's age and sex, school type, child's place of residence, grade level, parents' occupations, birth order, occurrences of parental death, and the number of people living in the household. Section C solicited information related to weight, height, and other health details, including instances of illness in the past four weeks, treatment for the illness, using mosquito nets while

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sleeping at night, and the frequency of handwashing before meals and after visiting restrooms.

Pre-testing the questionnaire

The questionnaire was pre-tested outside the study area. Pre-testing was carried out in one of the governments and private schools located in Morogoro region after the completion of formal training of research assistants. Subsequent to pre-testing the questionnaire, necessary adjustments were made based on the feedback and insights gathered from the respondents.

Administration of the Questionnaire

Before administration of the questionnaire the enumerators were trained to acquaint themselves with the questionnaire proper procedure to ask the questions and proper recording of the responses. The pre-tested questionnaire was then administered to the study subjects through face-to-face interviews. These interviews were conducted within the school premises during the mid-morning or lunch break hours of the day.

Measurements taken.

Anthropometric measurements involving weight, height, and age were taken according to standardized protocols outlined by the World Health Organization (WHO, 2007). Age of children was recorded from the administration form of children with the help from academic teacher. Weight and height were measured using standard procedures. Weight was measured using a standard weighting scale (digital electronic SECA scale; (Model 8811021659, German) that was kept on a firm horizontal surface. The subject was weighted without shoes and with light clothing by ensuring the removal of heavy-worn clothing such as sweaters and the weight was recorded to the nearest 0.1kg. Height was measured using stadiometer 9model no PE-AIM-101-USA) and recorded to the nearest 0.1cm. Subjects were requested to stand upright without shoes on their back kept against the wall and heels put together in a V-shape while looking forward. Each measurement was measured twice to find an average.

Data analysis

Data were compiled, coded, cleaned and analyzed using SPSS software version 26.0 for Windows and the WHO AnthroPlus tool. Data collected were entered into the WHO Anthro-Plus software (version 1.0.4), which facilitated computation of Z-score indices in line with the WHO's 2006 growth references for children aged 5-19 years(De Onis *et al.,* 2007). The indices used were height-for-age (HAZ), weight-for-age (WAZ), and body mass index-for-age Z-scores (BMIZ). The categorization of HAZ, WAZ, and BMI for age Z-score were as follows: <-3SD severe underweight or stunting or wasting, ≥-2SD to <-2.9SD moderate underweight or stunting or wasting, -1SD to -1.9SD mild underweight or stunting or wasting, ≥-1SD to ≤+1.9SD normal, +2SD to +3SD overweight or tall, and >+3SD obese or over tall slender. Within the SPSS software, demographic characteristics of primary school children were succinctly summarized and presented as frequencies and percentages. Nutritional status of primary school children was condensed into frequencies and percentages, depicting the number of children falling into each nutritional status category (underweight, normal, overweight, and obese). The correlations between various factors (treated as independent variables) and the nutritional status of children were analysed using the Chi-square (X^2) test. Fisher's exact test was employed when at least one expected value was below 5. Subsequently, all variables that exhibited p-values < 0.05 from the Chi-square test were incorporated into a multivariable logistic regression analysis. This multivariable model helped to account for confounding variables and elucidated the associations between these factors and the nutritional status of children. The dependent variable in this analysis was a binary variable denoting whether children were overweight/obese.

Ethical Consideration

Ethical approval for the execution of this study was obtained from the Tanzania

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National Institute for Medical Research (NIMR) reference NIMR/HQ/R.8a/Vol.IX/4250. Written consent was obtained from the parents of all school children who participated in the study, indicating their willingness to allow their children to participate. Written consent was also obtained from school officials, while pupils aged 6 to 13 years provided both verbal and written consent. To ensure confidentiality, each pupil was assigned an identification number.

Results

Characteristics of the primary school children

Most of the participants (67.3%, n=81) were aged between 6 and 9 years. There was a relatively equal distribution of male and female children (46.0% and 54.0%, respectively). Half of the children were in private schools, while the other half were in public schools. In terms of grade/class level, 58.1%, (n=144) of the children were in grades 1 to 3, and 41.9%, (n=104) were in grades 5 to 6. Employment was the most common occupation among fathers (35.9%, n=89), while among mothers, majority were businesswomen (37.5%, n=93). In terms of family structure, most children were from households with 1 to 3 adults (71.4%, n=177) while 61.7%, (n=153) came from families with 1 to 3 children. The birth order distribution showed that, majority of children were from families with 1 to 3, (48.8%, n=121). Majority of children (91.9%, n=228) had not experienced death of either parent as shown in (Table 1).

Table 1: Socio-economic and demographic characteristics of the primary school children (N=248)

Characteristic	No. of Respondents	%
Age		
6 – 9	167	67.3
10 – 13	81	32.7
Sex		
Male	114	46.0
Female	134	54.0
School type		
Private	124	50
Public	124	50
School location		
Rural	124	50
Urban	124	50
Grade/Class Level		
1 – 3	144	58.1
5 – 6	104	41.9
Fathers occupation		
Employed	89	35.9
Farmer	41	16.5
Businessman	76	30.6
Studying	40	16.1
I don't know	2	0.8
Mothers occupation		
Employed	57	23.0
Farmer	30	12.1
Businesswoman	93	37.5
Housewife	47	19.0
I don't know	21	8.5
Birth order		
1 – 3	79	28.2
4 – 6	121	48.8
> 6	57	23.0
Death of either parent		

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Yes	20	8.1
No	228	91.9
Number of adults		
1 – 3	177	71.4
4 – 6	63	25.4
> 6	8	3.2
Number of children		
1 – 3	153	61.7
4 – 6	95	38.3
> 6		

Environmental and other health risk factors affecting the health of primary school children

Among the selected participants, 17.7%, (n=44) preferred to drink boiled water, while majority, (82.3%, n=204), consumed unboiled water. The sanitation facilities used by children indicated that, 71%, (n=176) had access to flush toilets, whereas 29%, (n=72) utilized pit latrines. Regarding waste disposal methods, 73.4%, (n=182) used pit systems, 8.9%, (n=22) resorted to burning, 2.8%, (n=7) used in open dumping, while 14.9%, (n=37) relied on dustbin trucks. Four weeks preceding the survey, 58.9% of the participants experienced sickness, while 41.1% did not get sick. In terms of seeking treatment, majority of children (21%, n=52) sought medical assistance from government health facilities, while 9.7% of the children sought medical assistance from religious/missionary health facilities. Additionally, 14.9% of the children visited local pharmacies to purchase some drugs/pills, 2.4% consulted local or traditional healers, while the remaining (47.6%) did not seek any treatment. Sleeping under mosquito nets was practiced by a significant proportion of the children, with 89.9%, (n=223) using mosquito nets for protection against mosquitoes, while 10.1% did not use mosquito nets. Hand hygiene practices indicated that, 81.5% of the respondents washed their hands before taking meals and after visiting toilets while 73% washed their hands using water only as presented in (Table 2).

Table 2: Environmental and other health risk factors associated with Primary school children(n=248)

Characteristics	No. of Respondents	%
Drinking water		
Boiled	44	17.7
Not boiled	204	82.3
Kind of toilet facility		
Flush toilet	176	71
Pit latrine	72	29
Place to waste disposal		
Pit	182	73.4
Burning	22	8.9
Open dumping	7	2.8
Dust bin track	37	14.9
Sick in the past 4 weeks		
Yes	146	58.9
No	102	41.1
Seeking treatment		
Government	52	21.0
Religious/missionary	24	9.7
Pharmacy/drugstore	37	14.9
Local shop	11	4.4
Local herbs/traditional healer	6	2.4

None	118	47.6
Sleep under mosquito net		
Yes	223	89.9
No	25	10.1
Hands washing before meal		
Frequently	202	81.5
Infrequently	46	18.5
Hands washing after visiting a toilet		
Frequently	181	73
Infrequently	67	27
Materials used for handwashing		
Water only	238	96
Water and soap	10	4
Wearing shoes		
Sometimes	35	14.1
Always	213	85.9

Factors associated with nutritional status of the primary school children

Stunting

The chi-square test conducted for comparative analysis revealed significant associations between children's stunting rate and factors such as age, school type, birth order, parental death, and the number of children within the household as shown in (Table 3). This suggested that, children aged 10-13 years, those attending public schools, those born as fourth or later siblings, those who have experienced the death of either mother or father, and those living in households with more than four siblings were more likely to be stunted. Conversely, sex, school location, source of drinking water, and seeking treatment did not exhibit a significant association with stunting ($p>0.05$).

There was a relatively stronger tendency for male children, those attending schools located in rural settings, those who did not consume boiled water, and those who did not seek any treatment when sick to be stunted. Although these tendencies were not statistically significant, they indicated a higher likelihood of stunting among these groups of children as shown in table 3.

Table 3: Association between children's stunting (Height for Age Z-score) and socio-economic, environmental and health characteristics (N=248)

Characteristics	Stunted (n, %)	Normal (n, %)	P-Value
Age			0.000*
6 – 9	7(4.2)	16(95.8)	
10 – 13	19(23.5)	62(76.5)	
Sex			0.219
Male	15(13.2)	99(86.8)	
Female	11(8.2)	123(91.8)	
School type			0.021*
Public	19(15.3)	105(84.7)	
Private	7(5.6)	117(94.4)	
School location			0.060
Rural	18(14.5)	106(85.5)	
Urban	8(6.5)	116(93.5)	
Birth order			0.036*
1 – 3	4(5.7)	66(94.3)	
4 – 6	11(9.1)	110(90.9)	
>6	11(19.3)	46(80.7)	
Death of either parent			0.031*

Father	1(16.7)	5(83.3)	
Mother	4(36.4)	7(63.6)	
Both	0(0.0)	3(100)	
None	21(9.2)	207(90.8)	
Number of children			0.001*
1 – 3	8(5.2)	145(94.8)	
4 – 6	18(18.9)	77(81.1)	
Source of drinking water			0.587
Boiled	3(6.8)	41(93.2)	
Not boiled	23(11.3)	181(88.7)	
Seeking treatment			0.156
Government	9(34.6)	43(19.4)	
Religious/missionary	2(7.7)	22(9.9)	
Pharmacy/drugstore	0(0.0)	37(16.7)	
Local shop	1(3.8)	10(4.5)	
Local Herbs/traditional healer	0(0.0)	6(2.7)	
None	14(53.8)	104(46.8)	

*p-Value: Chi square test, *p<0.05; Fisher's Exact Test, **p<0.05*

Underweight

The chi-square test conducted for comparative analysis revealed that, there were no significant associations between children's underweight rate and their age, sex, school type, school location, birth order, death of either parent, number of children living in the household, type of drinking water, and the location where they seek treatment when they were sick. These factors did not show a significant association with underweight, (p>0.05) as shown in (Table 4).

There was a relatively higher tendency for children who were aged 6-9 years, male children, children in public schools, those studying in urban settings, children without both parents, children born as fourth or later siblings, those living in households with more than four children, children who consumed unboiled water, and children who did not seek any treatment or seek treatment from government health facilities to be underweight. Although these tendencies were not statistically significant, they increased the likelihood of underweight among these groups of children as shown in table 4 below.

Table 4: Association between children's Weight for Age Z-score and socio-economic, environmental and health characteristics (N=167).

Characteristics	Underweight (n, %)	Not underweight (n, %)	P-Value
Age			.[a]
6 – 9	9(5.4)	158(94.6)	
10 – 13			
Sex			0.733
Male	5(6.7)	88(95.7)	
Female	4(4.3)	70(93.3)	
School type			0.181
Public	6(8.2)	67(91.8)	
Private	3(3.2)	91(96.8)	
School location			1.000
Rural	4(5.1)	75(94.9)	
Urban	5(5.7)	83(94.3)	
Birth order			0.250
1 – 3	1(1.9)	53(98.1)	
4 – 6	5(6.0)	79(94.0)	

>6	3(10.3)	26(89.7)	
Death of either parent			0.174
Father	0(0.0)	4(100)	
Mother	1(33.3)	2(66.7)	
Both	0(0.0)	2(100)	
None	8(5.1)	150(94.9)	
Number of children			0.119
1 – 3	4(3.3)	116(96.7)	
4 – 6	5(10.6)	42(89.4)	
Drinking water			0.625
Boiled	2(8.0)	23(92.0)	
Not boiled	7(4.9)	135(95.1)	
Seeking treatment			0.367
Government	4(12.5)	28(87.5)	
Religious/missionary	0(0.0)	18(100)	
Pharmacy/drugstore	1(2.9)	33(97.1)	
Local shop	0(0.0)	8(100)	
Local herbs/traditional healer	0(0.0)	6(100)	
None	4(5.8)	65(94.2)	

*p-Value: Chi square test, *p<0.05; Fisher's Exact Test, **p<0.05, *[a] It is important to note that weight-for-age reference data were not provided beyond the age of 10 years. This was due to the fact, that this indicator does not differentiate between height and body mass during the age period when many children undergo pubertal growth spurt. Consequently, some children could appear to have excess weight based on weight-for-age, while in reality they were simply experiencing increased height.*

Wasting

The chi-square test conducted for comparative analysis revealed that, there were no significant associations between children's wasting rate and factors such as age, sex, school type, school location, birth order, parental death, number of children living in the household, type of drinking water used, and being sick in the past four weeks. These factors did not demonstrate any significant association with wasting($p>0.05$) as shown in (Table 5).

There was a relatively stronger tendency for the following childrengroups to experience wasting, children aged 6-9 years, female children, children attending public schools, children studying in rural settings, children without both parents, children who were born as fourth or later siblings, children living in households with more than four children, children who consumed unboiled water and children who had been sick in the past four weeks. Although these associations were not statistically significant, they indicated a higher likelihood of wasting among these groups of children as presented in table 5.

Table 5: Association between children Weight for Height Z-score and socio-economic, environmental and health characteristics.

Characteristics	Wasted (n, %)	Normal (n, %)	P-Value
Age			0.686
6 – 9	4(57.1)	163(67.6)	
10 – 13	3(42.9)	78(32.4)	
Sex			0.457
Male	2(28.6)	112(46.5)	
Female	5(71.4)	129(53.5)	
School type			0.120
Public	6(85.7)	118(49.0)	
Private	1(14.3)	123(51.0)	
School location			1.000

Rural	4(57.1)	120(49.8)	
Urban	3(42.9)	121(50.2)	
Birth order			0.928
1 – 3	2(28.6)	68(28.2)	
4 – 6	3(42.9)	118(49.0)	
>6	2(28.6)	55(22.8)	
Death of either parent			0.103
Father	1(14.3)	5(2.1)	
Mother	1(14.3)	10(4.1)	
Both	0(0.0)	3(1.2)	
None	5(71.4)	223(92.5)	
Number of children			0.110
1 – 3	2(28.6)	151(62.7)	
4 – 6	5(71.4)	90(37.3)	
Source of drinking water			0.611
Boiled	2(28.6)	199(82.6)	
Not boiled	5(71.4)	42(17.4)	
Sick in past 4 weeks			0.703
Yes	5(71.4)	100(41.5)	
No	2(28.6)	141(58.5)	

*p-Value: Chi square test, *p<0.05; Fisher's Exact Test **p<0.05*

Overweight/Obese

The chi-square test conducted for comparative analysis yielded significant associations between children being overweight/obese at both school type (private or public) and the number of children in the household as presented in (Table 6). This suggested that children attending private schools and those residing in their households with 1-3 children were more likely to be overweight/obese.

On the other hand, factors such as age, sex, school location (rural or urban), birth order, parental death, source of drinking water and seeking for treatment did not indicate a significant association with being overweight/obese (p>0.05). There was a relatively stronger inclination for children aged 10-13 years, female children, those attending urban schools, those in private schools, those living in households with more than four siblings, and children with both parents present to be overweight/obese as presented in table 6.

Table 6: Association between children Weight for Height Z-score and socio-economic, environmental and health characteristics.

Characteristics	Normal (n, %)	Overweight/obese (n, %)	P-Value
Age			0.822
6 – 9	16(9.6)	72(88.9)	
10 – 13	9(11.1)	151(90.4)	
Sex			0.534
Male	13(11.4)	101(88.6)	
Female	12(9.0)	122(91.0)	
School type			0.010*
Public	19(15.3)	105(84.7)	
Private	6(4.8)	118(95.2)	
School location			1.000
Rural	13(10.5)	111(89.5)	
Urban	12(9.7)	112(90.3)	

Birth order			0.284
1 – 3	4(5.7)	66(94.3)	
4 – 6	13(10.7)	108(89.3)	
>6	8(14.0)	49(86.0)	
Death of either parent			0.221
Father	1(16.7)	5(83.3)	
Mother	3(27.3)	8(72.7)	
Both	0(0.0)	3(100)	
None	21(9.2)	207(90.8)	
Number of children			0.008*
1 – 3	9(5.9)	144(94.1)	
4 – 6	16(16.8)	79(83.2)	
Source of drinking water			0.408
Boiled	6(13.6)	38(86.4)	
Not boiled	19(9.3)	185(90.7)	
Seeking treatment			0.148
Government	3(5.8)	49(94.2)	
Religious/missionary	2(8.3)	22(91.7)	
Pharmacy/drugstore	1(2.7)	36(97.3)	
Local shop	3(27.3)	8(72.7)	
Local herbs/traditional healer	1(16.7)	5(83.3)	
None	15(12.7)	103(87.3)	

*p-Value: Chi square test, *p<0.05; Fisher's Exact Test, **p<0.05*

Discussion

Prevalence of undernutrition and overnutrition among primary school children

The primary objective of this study was to assess the anthropometric status of primary school-aged children in both Dodoma urban and Chamwino districts, located in Dodoma. About 67.3%, (n=167) of the participants fell within the age range of 6 to 9 years, which was termed "the young strata." This age range was consistent with the Tanzanian national guidelines for admitting students to Standard I, in which children are required to be six years of age or older and possess the ability to read and write. According to the findings of this study, age was found to have a significant impact on the nutritional status of the children. This was consistent with a study conducted in Ethiopia(Berhanu *et al.*, 2023), which indicated that the risk of malnutrition tends to decrease as a child grows older.

Prevalence of stunting was found to be 15.3%, (n=19) in public schools and 5.6%, (n=7) in private schools within the study population. Stunting prevalence was observed to be higher among boys than in girls, and it also exhibited an upward trend with increasing age. Stunting prevalence was observed to be higher among boys than in girls, since boys have a higher likelihood of experiencing stunting compared to their girl counterparts this may be due to family size, gender bias, parents' attention to boys and parental preferences for male children in some areas (Adedeji *et al.*, 2017). This pattern could be explained by the understanding that, stunting is a form of chronic malnutrition that becomes more evident during later childhood stages. As the child's age surpasses the critical window of growth, the ability to reverse the stunting condition diminishes(*Bliznashka et al.*, 2021).

This observation aligns with findings from studies conducted in Tanzania and other African countries. These studies have consistently shown that, boys have a higher likelihood of experiencing stunting compared to their girl counterparts. The likelihood of a child to be stunted increases with age (Mohamed *et al.*, 2022).

Prevalence of underweight differed between public and private schools, with rates of 8.6%, (n=6) observed in public

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schools and 3.2%, (n=3) in private schools for children aged below 10 years. These differences can be attributed to various factors such as lifestyle variations, feeding habits, parental education and differences in socioeconomic status. There appeared to be a significant impact of rural and urban backgrounds on underweight prevalence. Children from rural areas tended to be more underweight compared to their urban counterparts. This trend of rural-urban variations has been reported in similar studies, even among children below five years of age (TNNS, 2018).

In this study, prevalence of thinness among school-aged children aged 6-13 years was approximately 2.8%, (n=7). The observed magnitude of thinness was lower when compared to findings from other studies conducted in various regions. For instance, studies conducted in Tanzania (11.2%), Ghana (19.5%), Forega, Ethiopia (21.4%), Southern Ethiopia (13.6%), Northern Ethiopia (26.1%), Nigeria (18.9%), and West Bengal, India (28%) reported higher prevalence rates of thinness among children aged 6-13 years (Mohamed *et al.,* 2022).

Prevalence of thinness differed significantly between public and private schools, with rates of 76.0% in public schools and 24.0% in private schools. This discrepancy could be attributed to the absence of school feeding programs in public schools, which may have led to extended periods of hunger or reliance on snacks that are purchased during break times. These factors could contribute to the higher prevalence of thinness among children in public schools (Mwaikambo *et al.,* 2015).

Students attending private schools usually come from families with higher socio-economic status. Wealthier families can afford school fees and might enrol their children in schools that offer school lunch programs. These families might provide transportation to or from school to home by private cars or school buses, ensuring easier access to nutritious meals. This context could explain the lower prevalence of thinness among children attending private schools. These observations are in line with a study conducted by Mwaikambo *et al.* (2015).

Underweights and thinness were higher among children in public schools than in private schools. Similarly, several studies indicated that underweights in public schools was more prevalent than in private schools (Mohammed *et al.,* 2022). This difference may be due to various factors such as lifestyle variations, feeding habits, parental education, difference socioeconomic status, this aligns with (Mwaikambo *et al.,* 2015). Residence in urban or rural areas is another contributing factor to underweight and thinness among schoolchildren. The current review revealed a higher prevalence of underweights and thinness in rural areas than in urban areas. Other findings of the present study included the high rate of slimness and underweights, in rural areas compared to urban areas. Possibly due to failure of access to food, safe water and sanitation where similar results have been reported in other studies in other parts of the world (Mohammed et al., 2022).

This study also revealed a lower prevalence of overweight/obesity among school aged children compared to similar studies conducted in Tanzania. For instance, a previous study conducted in Tanzania by Vincent et al. (2012) reported a 15% prevalence of overweight/obesity among school children aged 9-11 years. Another study involving primary school children aged 7-17 years in Arusha Urban, Tanzania, reported an overweight and obesity prevalence of approximately 18% (Chomba *et al.,* 2019). In the selected study sample, the prevalence of overweight/obesity among primary school children was 16.4% in public schools and 83.6% in private schools.

Urban schools exhibited a higher prevalence of overweight/obese pupils compared to the rural schools. This trend could be attributed to shifts in lifestyles and dietary behaviors across various population groups within the region. Environmental factors such as the increased availability of fast-food outlets in urban areas may have contributed to these trends. This phenomenon agreed with

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findings from a study conducted in Morogoro, Tanzania (Muhomba *et al.,* 2023).

Determinant factors of Stunting and Overweight/Obesity among primary school children

In the bivariate logistic regression analysis, several factors including the child's age, school type, birth order, parental death, and the number of children in the household were identified as independent predictors of stunting, with p< 0.05. Consequently, all these variables were included in a multivariable logistic regression model and upon adjustment, only age and the number of children living in the household maintained their significant associations (p<0.05) with stunting.

The study findings revealed that children aged 10-13 years had a lower likelihood of being stunted (Adjusted Odds Ratio, AOR = 0.26; 95% Confidence Interval: 0.09, 0.73) compared to siblings aged 6-9 years. Conversely, children living in households with more than four children were strongly associated with stunting (AOR = 2.718; 95% Confidence Interval: 1.076, 6.864) in comparison with children living in households with fewer than four children.

Both age and the number of children living in the household were identified as significant (p<0.05) predictors of stunting. Stunting demonstrated a noteworthy increasing trend with advancing age, with older age emerging as an independent predictor of stunting. This study highlights an inverse association, indicating that a decrease in age leads to 19% increase in the stunting rate of children aged 10-13 compared to children aged 6 to 9 years.

This observation was in line with previous reports showcasing the progression of height deficit with increasing age in sub-Saharan Africa(Mushtaq *et al.,* 2011). Having several siblings in the household greater than four was also a significant predictor of stunting among children. This observation might be attributed to a lower level of childcare and reduced dietary intake due to the larger number of children in the household. Similar findings have also been observed in other parts of the world(Yeasmin *et al.,* 2016).

Both bivariate logistic regression and multivariate logistic regression models revealed significant associations (p<0.05) between school type, the number of children living in a household and being overweight/obese. Results of this study indicated that children attending public schools were 0.041 times (Adjusted Odds Ratio, AOR = 0.357; 95% Confidence Interval: 0.133, 0.957) less likely to be overweight or obese compared to children in private schools. Moreover, children residing in families with more than four children were 0.042 times (AOR = 2.526; 95% Confidence Interval: 0.162, 0.905) more likely to be overweight or obese.

School type and the number of children living in the household were identified as significant (p<0.05) predictors of overweight/obesity. It was observed that 80% of pupils attending private schools were more likely to become overweight or obese compared to their counterparts in public schools. This phenomenon could be attributed to the fact that a considerable number of pupils in public schools skipped meals, which could lead to lower weights and undernutrition.

Increase in obesogenic environments was noted for children whose movements were restricted by their parents or guardians. This trend was noticed in children who had limited opportunities to engage in spontaneous physical activities. These findings are in line with those reported by(Pangani *et al.,* 2016). Children living in households with fewer than four children exhibited a positive association with being overweight or obese, unlike their counterparts in larger households. This situation arisen from the availability of sufficient and excess food for children in families with fewer members. This correlation was also reported by(Pangani *et al.,* 2016). It is crucial for the public to recognize these patterns as indicators of an increasing double burden: Children with ample food resources are more susceptible to overweight and obesity, while those facing

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food scarcity are at high risk of becoming underweight.

Conclusions and recommendations

This study provided significant insights into the prevalence of stunting, thinness, underweight, and overweight/obesity among pupils aged 6 to 13 years in both public and private schools in Dodoma. The prevalence of undernutrition was higher in boys than in girls, more common in public schools than in private schools, and more prevalent among pupils residing in rural areas. The prevalence of overnutrition was higher in private schools, more common among girls than boys, and prevalent among pupils residing in urban areas. The study also established a correlation between stunting and overweight/obesity. We hence recommend monitoring children's nutrition status in school and efforts should be directed towards providing school feeding programs in order to mitigate the consequences of undernutrition resulting from children experiencing hunger at school.

Strength and Limitation

The major limitation of this study was its failure to address the nutritional status of overfed children. A longitudinal study could have enabled the subjects to be profiled over time. Additionally, respondents' ability to accurately remember and answer certain questions was a limitation. Reporting of hygiene could have been inflated, as is often the case with self-reported hygiene behaviors. The education level of the children's parents could also introduce a source of bias.

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Data availability statement

The data that support the findings of this study are available upon request from the corresponding author.

Conflict of Interest

The authors declare no conflict of interest.

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