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School Health Promotion in Japan and its Contribution to Asia and Africa
Original Article

Has the double burden of malnutrition reached pupils in rural western Kenya?

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Abstract ***Background*:** Undernutrition and overnutrition have been considered separate challenges caused by the distinct factors in distinct settings. The double burden of malnutrition is defined as the coexistence of both undernutrition and overnutrition, which has now spread globally, especially in low- and middle-income countries. In Kenya, the double burden of malnutrition is present in the capital city but the situation in rural areas currently remains unknown. The aim of this study was therefore to analyze nutritional status in rural Kenya.

***Methods*:** Data from height and weight measurements conducted by teachers in the third term of school year 2013 were collected from primary schools. Teachers were trained by experts before starting the measurements. The Z-scores of height-for-age, weight-for-age, and body mass index-for-age were calculated using AnthroPlus, and nutritional status was defined according to the World Health Organization guidelines.

***Results*:** Data analyzed from 7,447 pupils (3,763 boys and 3,684 girls) showed that 12.4% were stunted and 7.8% were underweight among those ≤120 months old, and 11.7% were thin among those >120 months old. Boys were more likely to be stunted than girls. Boys were more likely to be underweight and girls were more likely to be overweight in the older age group.

***Conclusion*:** The double burden of malnutrition was not found, and undernutrition was still common among schoolchildren in the study area. However, it is important to monitor nutritional status due to adverse effects of rapid urbanization. Height and weight measurements in schools may be useful for monitoring the nutritional status of schoolchildren.

Key words double burden of malnutrition, Kenya, overweight, school health, underweight.

Malnutrition, including both undernutrition and overnutrition, has remained a global challenge[1,2] and is present in both adults and children.[3–5] As of 2014, more than 1.9 billion adults aged 18 years and older were overweight, and 462 million were underweight.[6] In 2019, 38 million children under 5 years old were overweight, 144 million were stunted, and 47 million were suffering wasting worldwide.[4] In high-income countries such as the USA, overnutrition has been a problem as a cause of non-communicable diseases (NCDs). In low- and middle-income countries (LMICs), too, overnutrition has been increasing as a problem, even though the problem of undernutrition still remains.[2,3]

Malnutrition has a big impact on health. Overweight and obesity can be linked to diet-related NCDs such as cardiovascular diseases and diabetes mellitus.[7,8] Undernutrition is linked to around 45% of deaths among children under 5 years old.[9] Although it may not be a direct cause among the principal causes of death in young children, undernutrition is responsible for 60.7% of deaths from diarrhea, 52.3% of deaths from pneumonia, 44.8% of deaths from measles, and 57.3% of deaths from malaria.[10] Moreover, malnutrition in childhood affects both physical and mental development, which later influence adulthood in terms of body size, motor ability, and learning ability, among other factors, and may also relate to the completion of schooling.[11]

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Over the past decades, the landscape of global nutrition has gradually changed to one of a "double burden of malnutrition," which is defined as the coexistence of undernutrition and overweight, obesity, or diet-related NCDs within individuals, households, and populations and across the course of life.[2,12] Before this concept was established, undernutrition and overnutrition were considered separate challenges in different populations with contrasting factors, such as poverty and food insecurity for undernutrition, and affluence and diet richness for overnutrition. However, the double burden of malnutrition can now be seen globally, especially in LMICs.[13–18] Countries in the highest quartiles of income among LMICs were the typical regions affected by the double burden of malnutrition in the 1990s, but recently, however, the level of this double burden has become much more severe in LMICs in the lowest income quartile, including countries in South Asia, East Asia, and Sub-Saharan Africa.[17] Rapid urbanization has been occurring in developing regions, especially in Africa, which has undergone the most rapid urbanization at 3.7% annually from 2010 to 2015. Nevertheless, income levels are much lower than those in other regions at similar levels of urbanization.[19] This urban poor setting contributes to increased food insecurity, more street food vendors, and more reliance on staple foods and processed foods, which are associated with higher intake of fat, sugars, and energy.[20] Thus, this rapid urbanization is linked to dietary changes and may consequently contribute to increasing overweight and obesity among low-income countries and populations.[21]

In Kenya, 26% of children under 5 years are stunted and 11% are underweight. Nevertheless, 33% of women aged 15–49 years are overweight or obese. Stunting among children under five is more common in rural areas (29%) than urban areas (20%), and overweight and obesity among women are more common in urban areas (43%) than rural areas, although the prevalence in rural areas is still high at 26%.[22] In previous studies conducted in 2008–2010 in an urban poor setting in Nairobi, Kenya, almost half of the children under five were stunted (46–47%), 11–12% were underweight, 2.5–2.6% were wasting, and 9% were overweight or obese.[23,24] Meanwhile, 32% of their mothers were overweight or obese and 7.5% were underweight.[24]

There have been various reports on the nutritional status of school-aged children. One study targeting 4- to 11-year-old children in public primary schools reported that 24.5% were stunted, 14.9% were underweight, and 9.7% were wasting.[25] Another study targeting 9- to 11-year-old children in both public and private primary schools showed that 3.7% were underweight, 14.4% were overweight, and 6.4% were obese.[26] One study targeting 10- to 15-year-old children indicated that pupils in private schools were more likely to be overweight/obese than those in public schools. The prevalence of overweight and obesity was 16.7% and 6.9%, respectively, in private schools but 5.7% and 1.6% in public schools.[27]

The above studies were conducted in urban settings, especially in slums in Nairobi Province. However, the situation in rural areas has remained unknown thus far. In recent years, it has been assumed that changes in dietary habits have diffused through rural areas in Africa. Energy-dense foods with minimal nutritional value, such as processed foods and sugar-sweetened beverages, have become available at relatively cheap prices in rural areas along with modernization and urbanization.[2,17,28] Thus, the aim of this study was to describe the nutritional status of schoolchildren in Mbita Sub-county, which is a relatively rural area in Homa-bay County, Kenya.

Methods

Study site

This study was conducted in four locations: Gembe East, Gembe West, Rusinga East, and Rusinga West in Mbita Sub-county, Homa-bay County, Kenya. A school health project was conducted in these areas by the Institute of Tropical Medicine, Nagasaki University (NUITM), which was funded by the Japan International Cooperation Agency (JICA). The population of the study site was 68 319 as of 2018.[29] All four locations are located along the shores of Lake Victoria, and the main source of income is fisheries.

Study sample

The study sample comprised all pupils who went to public or private primary schools (n = 102) in the study area that participated in the school health project.

Height and weight measurements

Height and weight measurements were introduced to primary schools by the school health project as one of the activities. First, officers from the Ministry of Education and Ministry of Health in Mbita Sub-county were trained as trainers for the measurement and recording of height and weight, its importance, and how to use the results. The training was provided during a 2 day workshop by officers from the central government and Japanese experts. Next, three teachers from each primary school in the study area were trained by these trainers under the supervision of central government officers and the Japanese experts. Height and weight scales and record sheets were provided by the project. Height and weight measurements in schools have been conducted during each school term (three terms per year) since 2013.

Data collection

Data on height and weight measurements obtained by trained teachers in each school were used for this study. The record sheets were collected from the schools once a year for data entry by the project team. The data collected in the third term of the 2013 school year were used to analyze nutritional status among the primary school children at the study sites. The students' dates of birth were confirmed by the Health and Demographic Surveillance System (HDSS) of NUITM.

Data analysis

Anthropometric indices, height-for-age, weight-for-age, and body mass index (BMI)-for-age were calculated based on the growth standards promulgated by the World Health Organization (WHO) using AnthroPlus v1.0.4 (WHO, Geneva, Switzerland). According to the recommendations of WHO, weight-for-age was used for children up to 120 months old, whereas BMI-for-age was used for children over 10 years old.[30] Height-for-age was used for all pupils. Other statistical analyses, including descriptive analysis and comparison of a frequency distribution by χ^2 testing, were conducted using STATA 16.1 (StataCorp LLC, College Station, TX, USA). A Z-score of height-for-age (HAZ) <−2 SD of the WHO Reference 2007 was defined as stunting. A Z-score of weight-for-age (WAZ) <−2 SD of the WHO Reference 2007 was defined as underweight, a Z-score of BMI-for-age (BAZ) <−2 SD of the WHO Reference 2007 was defined as thinness, and WAZ >2 SD of the WHO Reference 2007 or BAZ > 1 SD of the WHO Reference 2007 was defined as overweight according to the WHO guidelines.[31]

Ethical considerations

This study was approved by the Scientific and Ethics Review Unit of the Kenya Medical Research Institute (SSC Protocol No. 2916). Permission for research activity in schools was given by the local education office. The data used for this study were secondary data, so consent forms were not obtained from any of the individuals.

Results

Characteristics of participants

Height and weight measurements were recorded for 9,892 pupils (5,003 boys and 4,889 girls). The dates of birth were available for 7,452 of these pupils (3,766 boys and 3,686 girls) from the HDSS data. Furthermore, five pupils were excluded because they were beyond the age suitable for calculating anthropometric indices using AnthroPlus. Ultimately, data from 7,447 pupils (3,763 boys and 3,684 girls), 6,180 (3,138 boys and 3,042 girls) in public schools and 1,267 (625 boys and 642 girls) in private schools were analyzed. The mean ages were 139.5 ± 30.6 months for all pupils, 141.7 ± 30.2 months for the boys, and 128.5 ± 30.4 months for the girls (Table 1).

Table 1 Characteristics of the study participants (N = 7,447)

Characteristic	School type		Total
	Public	Private	
Sex, *n* (%)			
Boys	3,138 (50.8)	625 (49.3)	3,763 (50.5)
Girls	3,042 (49.2)	642 (50.7)	3,684 (49.5)
Age, months, mean (SD)	141.7 (30.2)	128.5 (30.4)	139.5 (30.6)

Nutritional status

Overall, 12.4% of the pupils were stunted, 7.8% were underweight among those less than or equal to 120 months old, and 11.7% were considered thin among those more than 120 months old (Table 2). HAZ and BAZ showed significant differences between the boys and girls (P < 0.001 for both), whereas WAZ did not show any difference between them. Boys were more likely to be stunted than girls. In the older age group, boys were more likely to be thin, and girls were more likely to be overweight (Table 2). HAZ tended to decrease along with age (Fig. 1).

Weight-for-age showed a statistical difference between the public schools and private schools. Pupils in the public schools tended to be underweight compared to those in the private schools, with a prevalence of 8.9% and 4.7%, respectively (P = 0.005, Table 3). As very few of the pupils in the older group attended private schools, BAZ and HAZ were not compared.

Discussion

In this study, the double burden of malnutrition was not found in the study area. Undernutrition was still common but girls were more likely to be overweight than boys in the older age group. Boys were also more likely to be stunted than girls in the study area. Public school children were more likely to be underweight than private school children in the lower age group.

Undernutrition is usually a result of poor dietary intake or disease. In addition, the following two scenarios are conceivable: (i) the problem of low weight due to lack of nutrition is increasing; (ii) the weight gain is not keeping up with the height increase accompanying growth. Regarding scenario 2, it may disappear as it grows, but scenario 1, it may have serious problems. The study area was a rural area in a relatively poor setting.[29] Aside from Mbita township, most of the remaining areas are extremely rural, and it is very difficult to access the town to buy junk food. The residents usually planted maize (as a staple food in Kenya) at home for self-consumption. Around 2011–2012, a severe drought affected East-African countries, including Kenya,[32] which resulted in food insecurity. The human intestinal parasite *Schistosoma mansoni* is also very common in the study area.[33,34] These conditions might relate to the nutritional status of children in the area.

Although the double burden of malnutrition was not found in the study area, it is still important to monitor nutritional situation. Rapid urbanization in LMICs has caused overweight and obesity among various age groups of low socio-economic populations due to changes in the food system and lifestyles.[2,5,17,21,26,35] Previous studies in Kenya reported that the double burden of malnutrition in children has been seen in urban slum settings.[24,26] According to the Kenya housing and population census in 2009 and 2019, the Kenyan population

Table 2 Distribution of Z-scores of height-for-age (HAZ), weight-for-age (WAZ), and BMI-for-age (BAZ) by sex

Sex	HAZ (N = 7,437)				WAZ (N = 7,437)				BAZ (N = 5,180)			
	Stunting <−2 SD	−2 SD≤ ≤2 SD	2 SD<	*P*-value	Underweight <−2 SD	−2 SD≤ ≤2 SD	Overweight 2 SD<	*P*-value	Thinness <−2 SD	−2 SD≤ ≤1 SD	Overweight 1 SD<	*P*-value
Boys, *n* (%)	573 (15.2)	3,044 (81.0)	142 (3.8)	<0.001	88 (8.0)	993 (89.7)	26 (2.3)	0.972	345 (13.0)	2,266 (85.5)	40 (1.5)	<0.001
Girls, *n* (%)	573 (15.2)	3,044 (81.0)	142 (3.8)	–	89 (7.7)	1,035 (90.0)	26 (2.3)	–	261 (10.3)	2,156 (85.3)	112 (4.4)	–
Total, *n* (%)	919 (12.4)	6,243 (83.9)	275 (3.7)	–	177 (7.8)	2,028 (89.9)	52 (2.3)	–	606 (11.7)	4,422 (85.4)	152 (2.9)	–

BMI, body mass index.

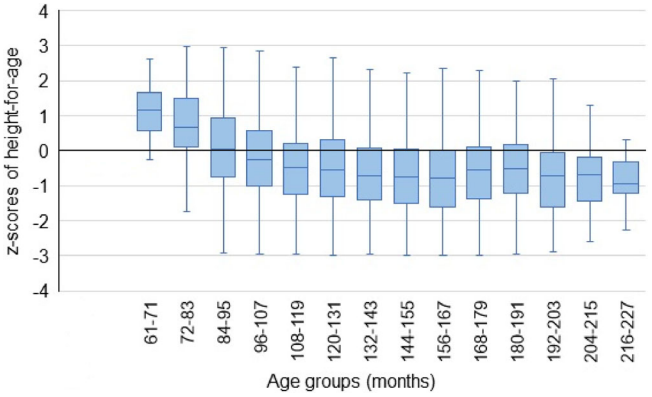

Fig. 1 Z-scores of height-for-age (HAZ) by age. [Colour figure can be viewed at wileyonlinelibrary.com]

Table 3 Distribution of Z-scores of weight-for-age (WAZ) by school type

Characteristic	WAZ (N = 2,257)			*P*-value
	Underweight <−2 SD	-2 SD≤ ≤2 SD	Overweight 2 SD<	
Public, *n* (%)	151 (8.9)	1,508 (88.8)	40 (2.3)	0.005
Private, *n* (%)	26 (4.7)	520 (93.2)	12 (2.1)	
Total, *n* (%)	177 (7.8)	2,028 (89.9)	52 (2.3)	

rose from 37.7 million to 47.6 million in this 10-year period, and the population in Homa-bay County in 2019 was 1.2 times the 2009 population.[29,36] Rapid population growth and rapid urbanization have led to slums and urban poor.

Town areas in the study area have been expanding due to population growth and a main road that connects to the capital of Homa-bay County, which was paved with asphalt in the middle of the 2010s. Thus, residents in the study area have much easier access to cheaper processed food. This study was conducted in late 2013, so it might not have caught the change in nutritional status that may have occurred with these background changes.

The girls in the older group (>120 months old) showed a greater tendency toward overweight than the boys in the study area. This result is consistent with previous studies that targeted schoolchildren or adults (>15 years old) in African countries.[37–40] One cause of overweight is an imbalance of energy between calories ingested and calories expended. Some causes of energy imbalance are an increased intake of energy-dense foods and increased physical inactivity. A study in Nairobi, Kenya, indicated that boys aged 9–11 years were more likely to engage in physical activities than girls.[26] The Kenya demographic and health survey of 2014 reported that 61% of women aged 15–19 years did not engage in any physical activity at all, whereas 36% of males in the same age group did not do any physical exercise.[22]

In contrast, a study in Brazil reported that boys aged 12–18 years were more overweight than girls,[41] and a study in

Indonesia showed no difference of overweight prevalence between boys and girls aged 8–10 years.[42] Our study also found that the younger age group did not show any difference in WAZ between boys and girls. This inconsistent phenomenon might be related to the difference of child growth patterns between boys and girls due to the variation of age range of the study samples. In addition, differences of environmental and sociocultural factors might contribute to this inconsistent phenomenon among countries. The present study also found that boys were more likely to be stunted than girls. This finding is consistent with several other studies[43–47] but the reason for this result is still unknown. Male sex has been considered a risk factor for preterm infants,[43,48] which might affect later body size.

The present study also showed that among the lower age group, pupils in the public schools had a tendency to be underweight compared to those in the private schools. This result is consistent with a previous study in Nairobi, Kenya,[27] although it reported a much greater incidence of overweight pupils in private schools than in public schools. In the study area, neither public nor private schools offered school lunch. Unlike private schools in urban areas, most of the private schools in Mbita do not have such a positive environment, but they could collect some contributions from parents / guardians of pupils and offer porridge to pupils as a 10 o'clock snack. This might be one reason for this phenomenon.

This study used data obtained by teachers in schools. It is unclear how accurate the teachers' measurements were, and this might be a limitation of this study. Studies in the USA showed that the measurements of height and weight by school staff and school nurses were accurate enough to screen students' BMI.[49,50] In addition, teachers in our study were all trained by central government officers and Japanese experts. We therefore considered the quality of the data to be good enough to screen the study children's nutritional status. In Japan, the measurement of height and weight and health checkups have been conducted in schools since the late 1800s, and the data have been used to grasp the dynamics of nutritional status among schoolchildren.[51,52]

There are some concerns about conducting height and weight measurements in schools. In the USA, it has been discussed that BMI measurements in schools might bring harmful consequences such as bullying and low self-esteem among malnourished children, and overreactions of parents.[53,54] In fact, some teachers in this study reported that even if the pupils were screened for malnutrition, it was difficult to consult or give advice to them and their guardians because of their economic situation – i.e., the guardians could not provide enough food for their children because of a lack of money or food insecurity.

However, according to the teachers in the participating schools, the pupils were interested in measuring their height and weight, which is a good entry point to developing an interest in their own health from a health education perspective. Thus, the measurement of height and weight in schools would appear to have merit for children's health. Another difficulty faced during the study was the confirmation of the schoolchildren's dates of birth. Most of the pupils did not know their dates of birth, and therefore, HDSS data were used to confirm them in this study. If height and weight measurements are introduced to schools, it will be necessary to consider how to accurately confirm dates of birth.

Conclusions

The double burden of malnutrition was not found in the study area in 2013, but undernutrition was still common among schoolchildren. However, rapid urbanization and rapid population growth have been occurring in the area, making it important to longitudinally monitor nutritional status. Height and weight measurements in schools may be useful tools for monitoring schoolchildren's nutritional status.

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Disclosure

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Author contributions

R.T. and J.K. designed the study. R.T., S.T., T. As., T. Ak., H.K., A.M., and B.W. performed training for the measurements. R.T. and H.K. performed data collection. R.T. performed data analysis. S.M.N., D.W.N., Y.K., and J.K. provided technical advice. R.T. drafted the manuscript. S.T., T. As., and J.K. critically reviewed the manuscript. All authors read and approved the final manuscript.

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