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Low for age weight status is not significantly associated with short-for-age body height in Kenyan schoolchildren – a pilot study

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Abstract

Background Stunting is commonly used as an indicator of malnutrition. Both are especially prevalent in Sub-Saharan Africa. Recently, the association between nutrition and growth has been questioned.

Objectives This study examined whether low weight status for age is significantly associated with short height for age of Kenyan children aged 3 to 10 years.

Sample and Methods Data were collected in Nairobi, Kiambu, and Kisumu in 1982, including 109 Kikuyu and 82 Luo children. The associations between age, sex, population, weight status, and body height were analysed.

Results Sex and low weight status for age showed no significant associations with short height for age. With increasing age, the likelihood of showing short height for age increased significantly ($p=0.001$). Furthermore, population affiliation had a significant impact ($p<0.001$), with Kikuyu children showing a 3.61 times higher risk of being short for age than Luo children.

Conclusion Weight-for-age as an indicator of nutrition is not significantly associated with short height-for-age in Kenyan schoolchildren. We question the suitability of standardized global tables for height percentiles for countries with heterogeneous populations.

Take home message for students

Low weight-for-age is not significantly associated with short height-for-age among Kenyan schoolchildren. We question the suitability of standardized global growth charts for heterogeneous populations.

Introduction

The growth process in the subadult phase of life is influenced by numerous intrinsic and extrinsic factors. In addition to genetic disposition, environmental factors are associated with the growth process as well. A particularly strong association is assumed between growth and nutrition. An undisturbed growth process is therefore widely interpreted as the result of adequate nutrition and a good state of health. Conversely, short body height for age, also known as stunting, is seen as an indicator of malnutrition and disease burden. To make the identification of children who are stunted, underweight, and/or are suffering from wasting more accessible, the World Health Organization (WHO) has defined growth charts based on weight-for-age and height-for-age standards.

One of the highest prevalence of stunting and low height-for-age is documented in Sub-Saharan Africa (Takele et al. 2022). As there is very little data available on the food intake and dietary patterns of children in Sub-Saharan Africa that can be linked to height-for-age, body mass index (BMI) for age percentiles is typically used as the primary indicator of their nutritional status (Akombi et al. 2017). Furthermore, stunting is interpreted as an indicator of undernutrition as Elmighrabi et al. (2023) pointed out in their meta-analysis of the prevalence of undernutrition among North African children.

While the association between stunting and chronic severe undernutrition is widely accepted, the close association between nutrition, growth, and final body height, has been critically questioned in recent studies (Dorjee et al. 2020; Scheffler and Hermanussen 2022; Hermanussen and Scheffler 2024). Instead of nutrition, the importance of psychosocial, economic, political, and emotional (SEPE) factors has been emphasized (Bogin 2021).

Based on the criticism of the association between weight-for-age and stunting (Dorjee et al. 2020; Scheffler and Hermanussen 2022; Hermanussen and Scheffler 2024), we tested the following hypothesis in this pilot study: A low weight for age status (BMI<15th percentile of weight-for-age standards of the WHO) has no significant influence on height for age (body height<15th percentile of height-for-age standards of the WHO) of Kenyan preschool and schoolchildren.

Material and methods

Study design

The data of the present study was collected during a project of the Institute of Human Biology, University of Vienna, Austria, in Kenya in July and August 1982. The project, co-financed by the Austrian Research Fund, aimed to establish school readiness criteria and collect data on body height and weight to create reference standards for school examinations in Kenya.

Only healthy children attending preschool or primary school in Nairobi, Kisumu, or Kiambu were included in the study. The schools were selected by the Kenyan authorities and the teachers and parents were informed about the aims and procedure of the examination.

Study population

221 children aged 3 to 10 years met the inclusion criteria, as they did not suffer from acute or chronic illnesses or disabilities. For the present study, only children

belonging to the two ethnic groups Kikuyu and Luo were included.

The present study included 191 children, 118 boys aged 4 to 10 years ($\bar{x}$=6.4; SD=1.2), and 75 girls aged 3 to 10 years ($\bar{x}$=6.2; SD=1.3). 109 children belonged to the Kikuyu group, 82 to the Luo group.

Location

The data was collected in 3 Kenyan cities: Nairobi, Kisumu, and Kiambu. Nairobi is home to about half of the children included in this study, 75 (68.8%) of them were Kikuyu, and 11 (13.4%) were Luo. More than one third of the children were situated in Kisumu. There were 70 Luo children (85.4%), but not a single Kikuyu child. The remaining children were from Kiambu, with 34 Kikuyu children (31.2%) and 1 Luo child (1.2%).

Anthropometry

Body height was determined in millimeters by the same trained person (E. Winkler) using a standard anthropometer (Sibner-Hegner Comp.). Body weight was recorded using a calibrated scale. The information on the procedure for measuring body height and body weight comes from the person who carried out the data collection (pers. communication from E. Winkler). BMI was calculated from height and weight using the formula weight in kg divided by height in m^2.

Short height was defined as a height below the 15^{th} percentile of the WHO height-for-age charts (WHO Multicentre Growth Reference Study Group 2006; Onis et al. 2007). Values below the 15^{th} percentile of the WHO's BMI-for-age charts were considered as low body weight (WHO Multicentre Growth Reference Study Group 2006; Onis et al. 2007).

Statistical analysis

The statistical analysis was carried out using SPSS (version 27.0). In addition to descriptive statistics, group differences were tested for statistical significance using Student t-tests and Fisher exact tests. We used binary logistic regressions to test the influence of sex, age, weight status, and population affiliation on height. A *p*-value below 0.05 was considered statistically significant.

Results

Short height-for-age (<15^{th} percentile) was found in 69 (36.1%) participating children. Considering the whole sample, boys showed a significantly higher risk (p=0.041; OR=1.82; 95%CI=0.97–3.39) for short height-for-age than girls (41.4% vs. 28.0%). A comparison of the two populations showed that stunting was significantly (p<0.001) more common in Kikuyu children than in Luo children. The significantly highest prevalence of short height-for-age (p<0.041) showed Kikuyu boys (52.0%). Low weight-for-age (<15^{th} percentile) was found in 66 (34.6%) of the participating children. Significantly more (p=0.046) boys (39.7%) showed low weight-for-age, while only 26.7% of the girls showed weight below the 15^{th} percentile of the reference sample. Low weight-for-age occurred insignificantly more often in Luo children than in Kikuyu children.

Table 1 presents population differences in the somatometric characteristics according to sex and age. Boys are mostly taller and heavier than girls of the same age class and the same population. Statistically significant sex differences in height occurred only among Kikuyu children younger than 6 years (p=0.013). Among Kikuyu children

Table 1 Somatometrics and population according to sex and age groups (student t-tests) of Kenyan children (in 1982).

	Kikuyu	Luo		Kikuyu	Luo	
	x (SD)/n (%)	x (SD)/ n (%)	p-value	x (SD)/n (%)	x (SD)/n/%)	p-value
	females			males		
<6 years						
n	13	8		25	10	
height (cm)	103.9 (5.3)	104.8 (7.2)	0.432	108.7 (7.1)	107.3 (4.7)	0.322
weight (kg)	16.3 (1.8)	16.3 (1.9)	0.388	17.4 (2.8)	16.9 (2.0)	0.276
BMI (kg/m^2)	15.10 (1.02)	14.82 (1.00)	0.267	14.64 (1.15)	14.74 (1.84)	0.418
low weight-for-age	2 (15.4%)	2 (25.0%)	0.498	8 (32.0%)	4 (40.0%)	0.470
short height-for-age	7(53.8%)	0 (0.0%)	**0.015**	9 (36.0%)	3 (30.0%)	0.530
6-7 years						
n	7	16		18	23	
body height (cm)	111.3 (6.1)	115.5 (3.6)	0.326	113.6 (4.1)	114.4 (4.1)	0.233
body weight (kg)	17.9 (2.3)	18.3 (1.9)	0.066	18.4 (2.0)	18.9 (2.2)	0.270
BMI (kg/m^2)	14.36 (0.86)	13.69 (0.98)	0.065	14.24 (1.03)	14.41 (1.10)	0.305
low weight-for-age	2 (28.6%)	10 (62.5%)	0.148	10 (43.5%)	6 (33.0%	0.369
short height-for-age	2 (28.6%)	0 (0.0%)	0.083	7 (38.9%)	5 (21.7%)	0.197
7-10years						
n	14	17		32	8	
body height (cm)	118.5 (7.5)	118.8 (6.5)	0.249	118.4 (5.2)	120.4 (5.1)	**0.028**
body weight (kg)	21.2 (2.7)	22.0 (3.7)	0.422	20.1 (2.5)	22.1 (2.7)	0.168
BMI (kg/m^2)	15.07 (0.85)	15.07(1.87)	0.180	14.27 (0.99)	15.21 (1.59)	**0.020**
low weight-for-age	1 (7.1%)	3 (17.6%)	0.378	16 (50.0%)	2 (25.0%)	0.193
short height-for-age	6 (42.9%)	6 (35.3%)	0.475	23 (71.9%)	1 (12.3%)	**0.004**
all age groups						
n	34	41		75	41	
body height (cm)	111.5 (9.1)	114.7 (7.6)	**0.047**	114.0 (7.0)	113.8 (6.2)	0.313
body weight (kg)	18.7 (3.2)	19.4 (3.6)	0.165	18.8 (2.7)	19.0 (2.8)	0.440
BMI (kg/m^2)	14.84 (0.94)	14.69 (1.63)	0.218	14.37 (1.06)	14.65 (1.35)	0.123
low weight-for-age	5 (14.7%)	15 (36.6%)	**0.029**	30 (40.0%)	16 (39.0%)	0.540
short height-for-age	15 (44.1%)	6 (14.6%)	0.005	39 (52.0%)	9 (22.0%)	0.001

older than 7 years, girls exhibited significantly higher BMI than Kikuyu boys of the same age class. Luo girls aged between 6 and 7 years were insignificantly taller than their male counterparts. Concerning population differences, Luo children were taller than Kikuyu children of the same sex and the same age group. The prevalence of short height-for-age was always higher among Kikuyu children. In the case of boys older than 7 years, this difference was statistically significant.

Table 2 demonstrates that short height-for-age ($<15^{th}$ percentile) was significantly influenced by age. With increasing age, the risk of being short for age increased significantly. Sex and low weight-for-age showed no statistically significant association with short height-for-age. The population however had significant impact on the risk of

Table 2 The impact of sex, age, low weight status and population on short height-for-age. Binary regression analyses (Short height-for-age=1, no short height-for-age=0) of 3–10 year old Kenyan children (in 1982)

	Reg Coeff	p-value	Exp (B)	95% CI
Short height-for-age (<15th percentile)				
Sex	-0.37	0.286	0.690	0.35–1.37
Age	0.31	0.025	1.369	1.04–1.80
low weight-for-age (<15th percentile)	-0.11	0.725	0.895	0.45–1.78
Kikuyu	1.28	<0.001	3.612	1.79–7.25
Luo	-1.28	<0.001	0.277	0.14–0.56

short height. This risk was 3.6-fold higher among Kikuyu children in comparison to Luo children.

Discussion

In the last 30 years, the prevalence of stunting has decreased worldwide from 40.0% to 22.0%. The prevalence of stunting is still highest in Africa with 30.8% for under 5-year-old children in 2022 (Tamir et al. 2024). As the prevalence of stunting can be assumed to have declined over the last three decades, it seemed expedient to focus on the situation in Kenya more than 40 years ago. It turned out that more than 36% of the participants were too short for age. But what caused short height for age? Today, inadequate psychological stimulation, poverty, infectious diseases, and poor nutrition are discussed as causes. The association between diet and height, however, has been increasingly questioned (Dorjee et al. 2020; Scheffler and Hermanussen 2022; Hermanussen and Scheffler 2024). Undoubtedly, severe malnutrition over a long period may result in impaired growth, a short height however is not always an indicator of poor nutrition.

Based on these new interpretations of the causes of stunting and short height for age, the present study tested the hypothesis that low body weight for age was not significantly associated with the prevalence of short height for age among Kenyan children. This hypothesis was verified. Low weight-for-age, defined as a BMI below the 15th percentile of the WHO reference, was not significantly associated with the prevalence of stunting defined as a height below the 15th percentile of the WHO standards (WHO Multicentre Growth Reference Study Group 2006; Onis et al. 2007). Despite the limitations, such as the small sample size of only 191 participants and the fact that no data on eating behavior was available, low weight for age was not significantly associated with low height for age in 3 to 10-year-olds. This corresponds to the results of Scheffler and Hermanussen (Scheffler and Hermanussen 2022; Hermanussen and Scheffler 2024).

There was a non-significant trend regarding sex. Boys showed insignificantly more often short height for age than girls. This observation was also reported in other studies (Tamir et al. 2024) and explained by a higher sensitivity of male children to stress factors. The present study also revealed a significant influence of population affiliation on body height. The risk of being short for age was significantly greater in Kikuyu children while belonging to the Luo population was associated with a significantly lower risk of short height for age. This is astonishing as the Kikuyu represent the dominant population in Kenya. Overall, Luo and Kikuyu differed significantly in height. This does not appear to be due solely to exogenous factors. Furthermore, this result may be seen as an indicator of the limited suitability of the WHO height and weight percentile curves, especially in heterogeneous populations, suggesting the need for population-specific growth standards.

Conclusion

Weight-for-age as an indicator of nutrition is not significantly associated with short height-for-age in Kenyan schoolchildren. We question the suitability of standardized global tables for height percentiles for countries with heterogeneous populations.

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