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ORIGINAL RESEARCH

Physical Activity, Sleep, and BMI Percentile in Rural and Urban Ugandan Youth

Mary J. Christoph, PhD, MPH, Diana S. Grigsby-Toussaint, PhD, MPH, Rhona Baingana, MS, James M. Ntambi, PhD

Minneapolis, Minnesota; Champaign, Illinois; Kampala, Uganda; and Madison, Wisconsin

Abstract

BACKGROUND Uganda is experiencing a dual burden of over- and undernutrition, with overweight prevalence increasing while underweight remains common. Potential weight-related factors, particularly physical activity, sleep, and rural/urban status, are not currently well understood or commonly assessed in Ugandan youth.

OBJECTIVE The purpose of this study was to pilot test a survey measuring weight-related factors in rural and urban Ugandan schoolchildren.

METHODS A cross-sectional survey measured sociodemographics, physical activity, sleep patterns, and dietary factors in 148 rural and urban schoolchildren aged 11-16 in central Uganda. Height and weight were objectively measured. Rural and urban youth were compared on these factors using χ^2 and *t* tests. Regression was used to identify correlates of higher body mass index (BMI) percentile in the full sample and nonstunted youth.

FINDINGS Youth were on average 12.1 $\pm$ 1.1 years old; underweight (10%) was more common than overweight (1.4%). Self-reported sleep duration and subjective sleep quality did not differ by rural/urban residence. Rural children overall had higher BMI percentile and marginally higher stunting prevalence. In adjusted analyses in both the full and nonstunted samples, higher BMI percentile was related to living in a rural area, higher frequency of physical activity, and higher subjective sleep quality; it was negatively related to being active on weekends. In the full sample, higher BMI percentile was also related to female gender, whereas in nonstunted youth, higher BMI was related to age. BMI percentile was unrelated to sedentary time, performance of active chores and sports, and dietary factors.

CONCLUSIONS This study is one of the first to pilot test a survey assessing weight-related factors, particularly physical activity and sleep, in Ugandan schoolchildren. BMI percentile was related to several sociodemographic, sleep, and physical activity factors among primarily normal-weight school children in Uganda, providing a basis for understanding weight status in the context of the nutrition transition.

KEY WORDS overnutrition, nutrition transition, sleep, physical activity, sub-Saharan Africa

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From the Department Pediatrics, University of Minnesota, Minneapolis, MN (MJC); Department of Kinesiology and Community Health and Division of Nutritional Sciences, University of Illinois Urbana-Champaign, Champaign, IL (DSG-T); Department of Biochemistry and Sports Science, College of Natural Sciences, Makerere University, Kampala, Uganda (RB); Departments of Biochemistry and Nutritional Sciences, University of Wisconsin-Madison, Madison, WI (JMN). Address correspondence to D.S.G-T. (dgrigs1@illinois.edu).

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INTRODUCTION

Sub-Saharan Africa is undergoing rapid transitions in physical activity and dietary patterns, contributing to a 35% increase in overweight and obesity over the past 2 decades.[1] Although chronic undernutrition remains a significant problem, with stunting affecting 38% of children younger than 5 in sub-Saharan Africa,[2] overweight prevalence is estimated at 15.4% of female and 7.6% of male schoolchildren. Despite the increased prevalence of overweight in recent decades, factors contributing to overweight are not well understood. Further, limited research has led to mixed conclusions; in children in the region, excess adiposity has been related to being female, having high socioeconomic status, and having urban residence,[3] in addition to nontraditional risk factors such as stunting[4] and higher wealth and human development.[5] One study, surveying adolescents in 7 African countries, even reported that excess weight was related to being younger, having increased fruit consumption, having greater parental involvement, and taking a greater number of physical education classes.[6] However, because prior research has occurred in relatively small samples and assessed a limited number of factors potentially related to weight, little is known about correlates of body mass index (BMI), and particularly high BMI, in youth in sub-Saharan Africa.

In Uganda, a low-income sub-Saharan African country of 35.8 million, underweight in children younger than 5 years old decreased dramatically over the last 20 years to 16.4% currently; additionally, 5% of children are wasted and one-third are stunted, whereas 3% are overweight.[7] The coexistence of undernutrition and overweight is striking because both undernutrition[8,9] and obesity[10] increase chronic disease risk. In Ugandan adults, a recent population-based survey found that almost 95% of those surveyed exhibited at least 1 of 5 noncommunicable disease risk factors assessed.[11] Preliminary studies have supported the rise of overweight and noncommunicable diseases and the need for assessing and shifting resources toward noncommunicable diseases.[12,13] Overweight among adult women has been found to be related to living in urban areas and being in the highest wealth class.[14] Although population-based surveys have assessed weight status and nutritional factors in adults and children younger than 5,[7,11] few studies have measured weight status and related factors in school-aged youth. One, which surveyed youth in both Uganda and Ghana, found that 10.4% and 3.2% of female and male adolescents were overweight[15] but was unable to report on many potentially confounding factors such as socioeconomic status, rural/urban status, and sleep. These gaps are particularly important because research in the United States and other countries has suggested they play a substantial role in obesity risk.[16,17] Further, because of the rapid pace of development in Uganda, prevalence of risk factors may be quickly changing and may be especially increasing in urban areas. Prior research has found higher rates of obesity[3,14,18,19] and diabetes[19] among urban children or adults in sub-Saharan Africa. Although risk factors such as physical activity and sleep are not as well studied in the region, research in China,[20] Haiti,[21] and Brazil[22] has suggested that rural-urban differences may exist in sleep quality or deprivation, and research in Cameroonian adults has found lower activity levels in urban dwellers.[23] In Uganda, the limited number of population-based studies, particularly in youth aged 6-18, make it difficult to gain a clear understanding of the risk and protective factors for under- and overweight in the context of the nutrition transition and how public health officials and practitioners can best promote nutrition and child health.

To attempt to address this gap in knowledge surrounding child weight and factors related to child weight, a survey was developed to assess factors associated with weight status in Ugandan youth. This cross-sectional survey was then piloted in a sample of 148 rural and urban primary schoolchildren in 2 central Ugandan schools to provide a baseline description of weight-related factors and investigate their relationship to BMI. Based on prior research in both the US and sub-Saharan Africa, we hypothesized that higher weight status would be related to female gender,[3,15] urban residence,[3] lower physical activity,[24,25] and lower sleep duration.[16] Because of previous research finding no relationship or very limited relationships between dietary factors and BMI percentile in sub-Saharan African youth,[6,15] no *a priori* hypothesis concerning dietary factors could be made.

METHODS

Study Design and Setting. Based on an estimated overweight prevalence of 6.8%[15] and 95% confidence, a power analysis found that at least 100 participants would be necessary to effectively study the impact of risk factors on overweight. Students were sampled from a large urban primary school in

Kampala, a city of 1.6 million people, and a large rural primary school in Mukono District, where the largest city has a population of 59,000. Both schools were located in East-Central Uganda and predominantly populated by residents of the majority ethnic group (Baganda); besides English, residents in both areas primarily spoke Luganda. Both schools operated from 8 AM to 5 PM, with 40 minutes of physical education each day that included a variety of activities and games, warming up, running, and skipping. Each school had a 30-minute morning break and an hour-long lunch break; the rural school also had another hour-long afternoon break. Both schools offered a school lunch of posho (cornmeal), pinto beans, and greens for the equivalent of US$8-$10 per trimester or US$24-$30 per year.

Survey Development. Modified versions of several surveys were combined and adapted for this population to assess demographics, physical activity, dietary factors, and sleep. Demographic characteristics included factors such as age, sex, grade, household assets and living conditions, parental wealth and education, and marital status, based on surveys previously used in youth and young adults in sub-Saharan Africa.[15,26] A wealth index variable was developed by indexing variables (scaled 0-12) related to assets, including amount of monthly allowance; being unable to pay school fees in the last month; ownership of a television, computer, and phone; and having electricity, a toilet, and internal water piping, similar to a previous study in Uganda.[7]

Twenty-four physical activity questions were based on questions from the Uganda Global School-Based Student Health Survey GSHS,[15] the SPARK program,[27] and the International Physical Activity and Environment Network.[28] These assessed children's participation in listed activities (eg, football, skipping rope) in the last 7 days, being physically active for at least 60 minutes in the past 7 days and in a typical week, how many days in a typical week a child performed active chores such as digging or walking/biking to the market, how many days in a typical week a child performed muscle-strengthening activities such as pushups or 3 situps, how many hours per day in a typical day were spent being sedentary, the length of time and mode of transport for commuting to and from school, enjoyment of physical activity, and plans to be active in the future.

Sleep quantity was assessed via 5 questions that were similarly phrased to previous research.[29] Four questions asked, "During the *past week*, what time have you usually turned out the light and gone to sleep on *school days/weekend days*?" and "During the *past week*, what time have you usually woken up in the morning on *school days/weekend days*?" The last question asked, "During the past week, how would you rate your sleep quantity? (How much you sleep overall)," with responses ranging from 1 = very good to 4 = very bad. Subjective sleep quality was assessed by the question, "During the past week, *how well did you sleep*?" with responses ranging from 1 = very good to 4 = very bad.

Dietary factors were assessed similarly to the Global School-Based Student Health Survey.[15] Fruit frequency was assessed via the question, "During the past 7 days, how many times per day did you usually eat fruit, such as ripe bananas, mangoes, oranges, guavas, avocado, or pawpaw?" Vegetable frequency was assessed via the question, "During the past 7 days, how many times per day did you usually eat vegetables, such as dodo, ggobe, ntula, sukuma wiki, bugga, or nakati?" and animal protein frequency was assessed by the question, "During the past 7 days, how many times per day did you usually eat food containing animal protein, such as milk, eggs, meat, fish, or chicken?" Response options for all 3 ranged from A = I did not eat fruit/vegetables/food containing animal protein during the past 7 days to G = 5 or more times per day.

Data Collection. ***Survey administration.*** A research coordinator recruited 2 schools in September 2013. In early November, parental information and consent forms were distributed to randomly selected students in primary grades 4-6, and parents were also informed verbally of the study at a community-wide meeting at the rural school. On obtaining participant assent, surveys were administered in English, an official language in Uganda and the primary language spoken in all schools. To ensure comprehension, each question was read in English and then orally translated into a local language, Luganda. Two study investigators oversaw all survey procedures; surveys were administered by bilingual teachers and the research coordinator. Most questions had accompanying pictures to facilitate understanding.

Data collection occurred over 2 consecutive days in mid-November 2013. The research team spent 1 day at each school; the survey took 2.5-3 hours (with one 10-minute break), and anthropometric measures took approximately 1 hour (but less than 5 minutes per adolescent). Of the 152 students recruited, 149 (98%) were eligible to participate (n = 74 urban, n = 75 rural), having returned

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parental consent forms and attended school on the data collection days.

Anthropometric measures. Height and weight were measured in accordance with World Health Organization standards[30] by 2 researchers with training on anthropometric measures. Body weight was measured in kilograms with a standardized scale (Tanita BF680W, Arlington Heights, IL). Children removed shoes and socks, stepped onto a scale, and stood still for 5 seconds. A subset (36%) of youth were measured twice to ensure accuracy; dual measures were within 0.2 kg in every case and not significantly different. Height was measured using a standard tape measure against a wall; children removed shoes and socks and stood against the wall looking straight ahead.

Statistical Analysis. One child was excluded for failing to list his or her sex, leaving a sample size of 148 children 11-16 years old. BMI-for-age and height-for age percentiles by gender were based on the World Health Organization references for children aged 5-19.[31] Weight status categories were compared with prevalence rates in US youth aged 2-19 years old[32] from the same period to give a comparison.

Both χ^2 and t tests were used to evaluate associations and differences in sociodemographic characteristics and physical activity by rural/urban residence. Generalized linear regression was performed to assess the relationship between hypothesized predictors (sex; rural/urban status; age; wealth; activity and sedentary time; sleep quality; and frequency of consuming fruits, vegetables, and protein) and BMI percentile as the outcome variable. Regressions were performed using the whole sample (N = 143 because of 5 youth with some missing data) and on just nonstunted children (N = 109 as a result of 3 youth having missing data; *nonstunted* meaning being above the fifth percentile for height for age) because of the limited applicability of BMI as a measure of health in this population.[4,33] All analyses were performed using SAS Version 9.4 (SAS Institute, Cary, NC).

This study was approved by the Institutional Review Board (no. 13873, July 8, 2013) at the University of Illinois at Urbana-Champaign and by the School of Biomedical Sciences Research and Ethics Committee, Makerere University College of Health Sciences. It was registered with the Uganda National Council for Science and Technology (Reg. no. HS1459). All procedures were carried out following the rules of the Declaration of Helsinki of 1975.

RESULTS

Study Population. Demographic characteristics and height and BMI percentiles are presented in Table 1. Of the 148 children (n = 73 urban, n = 75 rural), nearly half were male (n = 73, 49.3%); mean age was 12.1 years (±1.1). Age and sex did not differ significantly by rural/urban school status. Urban children were more likely to have a family that owned a TV or computer. Urban children were significantly more likely to have electricity in their home.

Stunting was marginally higher for rural children; BMI percentile was higher in rural children overall and among nonstunted children. Underweight (less than the fifth percentile for BMI) affected almost 10% of students and was more common in urban children. Only 2 children, 1 in each school, were above the 85th BMI percentile based on their age and gender.

Physical Activity. Results for physical activity are reported in Table 1. Urban students reported performing muscle-strengthening activities such as pushups or situps more often than rural children. Active transport was extremely common; all but 3 children reported walking to school every day. Both rural and urban youth reported spending an average of 30-40 minutes each weekday walking to and from school. Rural children reported higher expectation to be active as adults. More than 90% of both rural and urban youth reported having performed at least 1 sport and at least 1 chore in the past week. The top chores reported were fetching water (85%) and digging/gardening (44%). Digging, herding animals, and fetching water were all marginally higher for rural children versus urban. For sports and recreational activities, the most common were dancing (63%), football/soccer (55%), and skipping rope (39%). Urban students were more likely to have played baseball, cricket, rugby, or handball in the past 7 days, whereas rural students were more likely to have danced in the past 7 days.

Sleep Duration and Quality. Measures for sleep duration and subjective sleep quality are reported in Table 1. Children slept an average of 8.4 hours every weeknight, which did not differ significantly by rural or urban status. Females slept on average 8.4 hours (±1.0), while males slept an average of 8.5 hours (±1.3), a nonsignificant difference. The majority of students in both schools rated both their sleep quantity (88% for urban and 87% for rural) and subjective quality (89% for

Table 1. Sociodemographic Characteristics, Height and BMI Percentiles, Subjective Sleep Quality and Quantity, and Physical Activity Behaviors for 148 Students by Rural/Urban Residence in 2 Central Ugandan Schools

Sociodemographic and Behavioral Factors	Urban	Rural	P^*
	N (%)	N (%)	
Age ± SD	12.2 ± 1.3	12.1 ± 1.0	.708
Sex: male	36 (49.3)	37 (50.7)	.998
Height percentile, all children ± SD	30.2 ± 24.0	23.4 ± 23.2	.083
Number stunted (less than fifth height-for-age percentile)	13 (17.8)	23 (30.7)	.068
Underweight (less than fifth percentile)	9 (12.3)	5 (6.7)	.239
BMI percentile, all children ± SD	**35.9 ± 25.3**	**44.3 ± 24.6**	**.045**
BMI percentile, nonstunted ± SD (n = 112)	**36.4 ± 25.5**	**48.5 ± 24.0**	**.012**
Missed school 1 or more days in the past mo	23 (31.5)	20 (26.7)	.517
Family owns computer	**15 (20.6)**	**5 (6.7)**	**.014**
Family owns TV	**54 (74.0)**	**38 (50.7)**	**.004**
House connected to electricity	**52 (71.2)**	**41 (54.7)**	**.037**
Wealth index (range: 0-12 where 12 = highest) ± SD	4.7 ± 2.3	4.2 ± 1.8	.115
Physical Activity Behaviors			
Days/wk physically active ± SD	4.7 ± 2.4	4.1 ± 1.9	.109
Days/wk performing chores (0-7) ± SD	4.5 ± 2.5	4.4 ± 2.4	.842
Days/wk performing muscle-strengthening activities	**3.8 (2.4)**	**1.3 (1.7)**	**<.001**
Active ≥3 h on average weekend day	23 (31.5)	16 (21.3)	.160
Walk to school 5 d/wk	70 (95.9)	75 (100)	.207
Walk to school <30 min	38 (52.1)	48 (64.0)	.141
Expectation to exercise as an adult (1-5) ± SD	**3.1 (±1.0)**	**3.7 (±0.7)**	**<.001**
Inactive for <3 h/d	43 (58.9)	34 (45.3)	.099
Active Chores			
Chores, any	69 (94.5)	70 (93.3)	.763
Digging	24 (35.8)	36 (50.7)	.078
Herding animals	17 (23.9)	28 (38.4)	.062
Collecting firewood	18 (25.4)	20 (27.0)	.819
Fetching water	66 (90.4)	59 (79.7)	.070
Active Sports			
Sports, any	67 (91.8)	73 (97.3)	.135
Football/soccer	40 (55.6)	41 (54.7)	.914
Baseball	**17 (23.6)**	**1 (1.4)**	**<.001**
Cricket	**11 (15.3)**	**1 (1.4)**	**.002**
Rugby	**12 (16.9)**	**3 (4.1)**	**.011**
Handball	**27 (38.0)**	**11 (14.7)**	**.001**
Dance	**39 (53.4)**	**54 (73.0)**	**.014**
Playing with a tire	16 (21.9)	24 (32.4)	.152
Skipping	27 (38.6)	29 (38.7)	.991
Swimming	8 (11.6)	3 (4.0)	.087
Subjective Sleep Quality and Quantity			
Average weeknight sleep duration ± SD	8.4 ± 1.3	8.5 ± 1.1	.513
How well would you rate your sleep quantity? (very good)	64 (87.7)	65 (86.7)	.326
How well would you rate your sleep quality? (very good)	65 (89.0)	72 (96.0)	.343

SD, standard deviation.
* Significant differences at the level of $P < .05$ are bolded.

urban and 96% for rural) as "very good," the highest option possible.

Diet. Rural and urban youth differed in terms frequency of fruit consumption, with rural youth consuming fruit an average of 1.75 times/day while urban youth consumed fruit an average of once daily (rural = 3.7 ± 1.9, urban = 3.0 ± 1.8; $P = .018$). Although not a significant difference, rural children also reported consuming more vegetables, on average almost once daily, whereas urban children reported consuming vegetables less than once daily to once daily (rural = 2.9 ± 1.9, urban = 2.5 ± 1.8; $P = .264$).

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For protein, rural youth consumed moderately more, reporting an average of once daily, whereas urban youth reported consuming protein less often, between less than once daily to once daily (rural = 3.0 ± 1.6, urban = 2.5 ± 1.7; $P = .065$).

BMI Correlates. Table 2 shows regression results for the relationships among school, sex, age, wealth index, activity and sedentary time, participation in sports and chores, subjective sleep quality, and dietary factors and BMI percentile. In the full sample, BMI percentile was positively related to being female, rural, and reporting being active a greater number of days in the past week and having higher subjective sleep quality; it was negatively related to being active on weekends. In nonstunted children, BMI percentile similarly positively related to being rural, active on more days of the week, and having higher sleep quality and negatively related to being more active on weekends. However, in the nonstunted sample, BMI percentile was no longer related to being female and it was positively associated with higher age.

DISCUSSION

This pilot study was one of the first to assess physical activity, sleep, and BMI percentile among rural and urban schoolchildren in Uganda. Whereas 10% of children sampled were underweight, less than 2% were overweight. Contrary to our hypothesis, urban children had lower BMI percentile even after accounting for the high prevalence of stunting in rural children. Rural and urban children did not differ significantly in sleep duration and subjective sleep quality but differed in types of activities and expectation to exercise as an adult. In both the full and nonstunted samples, higher BMI percentile was related to being rural, being physically active, and having higher subjective sleep quality; in the full sample, higher BMI percentile was also related to being female. The model including sex, school, age, wealth index, weekend and daily activity and sedentary time, participation in chores and sports, subjective sleep quality, and dietary factors explained 24% and 27% of the variability in BMI percentile among the full sample and among nonstunted youth, respectively.

That BMI percentile was associated with being female in the full sample concurs with previous research in children in sub-Saharan Africa.[3] Other predictors, however, present a more nuanced view of weight in this population and did not align with our hypotheses that higher BMI percentile would be related to urban residence, lower physical activity, and poorer sleep quality. One important consideration is higher BMI percentile in this sample may be indicative of better health because only 2 children sampled were above the 85th percentile for BMI and the average BMI was less than the 50th percentile. This would not necessarily be surprising given that underweight is still more than 3 times more common than overweight in children younger than age 5 in Uganda[7] and was 7 times higher in

Table 2. BMI Percentile in Relation to Sex, School, Age, Wealth Index, Activity, Subjective Sleep Quality, and Dietary Factors in the Full Sample and in Only Nonstunted Children

	Full Sample (N = 143)			Nonstunted (N = 109)		
	Coefficient	SE	P^*	Coefficient	SE	P^*
Sex: female	**9.0**	**4.0**	**.028**	6.9	4.6	.140
School: rural	**12.8**	**4.2**	**.003**	**11.0**	**4.9**	**.027**
Age	2.5	1.8	.171	**4.5**	**2.1**	**.036**
Wealth Index	1.6	1.1	.134	1.2	1.3	.372
Participates in sports: yes	−5.7	9.7	.559	1.2	10.6	.912
Participates in chores: yes	6.2	9.2	.501	10.0	11.9	.401
Active hours on the average weekend day	**−4.1**	**2.1**	**.046**	**−6.4**	**2.6**	**.016**
Days/wk physically active	**3.2**	**1.0**	**.001**	**2.9**	**1.1**	**.011**
Sedentary activity	−1.9	1.4	.171	−1.4	1.7	.407
Sleep quality in past wk	**12.3**	**5.6**	**.029**	**13.1**	**6.0**	**.031**
Fruit frequency	0.4	1.3	.744	0.7	1.6	.676
Vegetable frequency	−0.9	1.1	.404	−1.0	1.3	.450
Protein frequency	−2.2	1.5	.155	−3.0	1.8	.108
R^2			23.6%			26.8%

SE, standard error.
* Significant associations are bolded.

this sample. Figure 1 compares the weight status distribution in this Ugandan sample to a nationally representative US sample.[32,33] Notably, the Ugandan sample had substantially higher underweight and normal weight prevalence, whereas US adolescents (12-19 years old) had substantially higher overweight and obesity prevalence. This difference in prevalence of underweight and normal weight is a possible contributor to why higher BMI percentile was, contrary to our hypothesis, related to positive health factors including better subjective sleep quality and more frequent physical activity. However, higher BMI percentile may have only been indicative of better health in nonstunted youth, because prior research in stunted youth has found that higher BMI is associated with poorer health behaviors.[34] It was thus crucial to analyze the nonstunted and full samples separately to better account for the higher prevalence of stunting and low height particularly in rural youth. Low height for age and socioeconomic and neighborhood differences in particular may have contributed to the higher BMI percentile in rural youth.

Prior research has reported conflicting evidence on the relationship between physical activity and BMI percentile in sub-Saharan African youth. In Cameroon, 1 study reported that overweight students had higher resting energy expenditure and physical activity than nonoverweight children.[34] Research in Kenyan schoolchildren, however, has found that overweight and obesity are negatively related to meeting physical activity guidelines[24] and being active.[35] In this sample, higher BMI percentile was positively related to more frequent activity while being negatively related to lower activity on weekend days. This discrepancy likely relates to reasons for activity (eg, transportation, participation in chores or sports) and the amount and types of activities performed over a week versus exclusively on weekends. The relationship between physical activity and BMI percentile is also modified by sex. In the present sample, physical activity was lower for girls, in agreement with other research in sub-Saharan Africa.[25,35]

Sedentary time and involvement in chores and sports was unrelated to BMI percentile in both the full and nonstunted sample. More than 90% of children reported participating in at least 1 chore and at least 1 sport over the past week. Almost 98% of children in this sample walked to school 5 days per week, which is higher than the 45.7%,[36] and 72%[37] of youth using active transport daily previously reported in Kenya. Active transport and physical activity measures have rarely been assessed in this population and vary widely by study location and design, and it is thus unclear if these results are typical. Future research on physical activity among Ugandan and sub-Saharan African youth should further assess different types of physical activity, both in and out of schools, and measure the relationship between gender and types of activity.

In the current study, frequency of consuming fruits, vegetables, and protein were unrelated to BMI percentile in both the full and nonstunted samples. One study found that fruit and vegetable intake was unrelated to overweight status in youth in Ghana and Uganda,[15] whereas another in 7 African countries reported that youth weight status was unrelated to food security and intake of vegetables, fast food, and soft drinks.[6] The relationship between dietary factors and BMI should be further assessed, with a focus on tailored survey development and a better understanding of school, neighborhood, and family factors.

Our study represents an in-depth cross-sectional survey of variables associated with body weight in Ugandan children. Although studies in Uganda and sub-Saharan Africa have reported differences in weight status by rural/urban residence and socioeconomic status,[3] this study further investigated factors such as subjective sleep quality and quantity and different types of physical activity and sedentary time in this rural-urban comparison study. Currently, few nationally representative studies of body weight in sub-Saharan Africa children exist; the International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE)[38] and other multinational studies are working to address this gap, which is particularly important because how environmental factors associated with weight differ between developed and developing countries is not

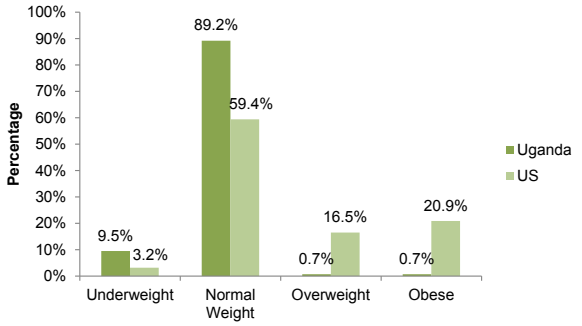

Figure 1. Weight status distribution comparison of Ugandan and US youth, surveyed during 2013 and 2013-2014, respectively.

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well understood. ISCOLE has noted that studies must endeavor to observe weight status and child health in the context of the country and be tailored to regional and cultural differences.[39] In school-based research, it will be particularly important to observe how school-related factors such as lunch offerings, physical activity programs, and school facilities may affect weight and health outcomes.

Strengths and Limitations. This study has several strengths. First, it provided baseline knowledge about socioeconomic status, physical activity, sleep, and related factors in relation to BMI in rural and urban Ugandan youth, building on prior studies surveying only a limited number of outcomes. Second, the developed survey included validated measures that were adapted to Ugandan youth, culturally tailored, and pictorial; additionally, youth reported understanding the questions. Third, this study was able to look at rural-urban differences, which may have important implications for weight in sub-Saharan Africa, where urban areas are experiencing a nutrition transition.[40] Last, height and weight were objectively measured, providing an important improvement over self-reported anthropometric measures.

This study also had several limitations. First, as a cross-sectional study, it could not provide information about the effects of different variables on weight over time. Further, although the majority of survey questions were adapted from previously validated surveys in other populations of children and adolescents in sub-Saharan Africa and the United States, the survey had not been previously validated in its entirety in Uganda. Another limitation is the use of self-report for assessing physical activity, sleep, and other measures. Self-reported measures of physical activity do not always show high validity,[41] and better cost-effective measures are needed to assess activity. This limitation was addressed by surveying about specific activities, which can produce more accurate responses.[42] Further, this survey did not assess pubertal status, which affects BMI,[43] and particularly may contribute to gender differences in BMI at this age. The small sample size and ability to collect data in only 2 schools limits inferences to similar schools in Uganda; however, as a feasibility study, it provided a baseline for working with schools to understand the risk factors associated with weight status and health in this population.

CONCLUSIONS

This study was one of the first to pilot test a survey measuring weight-related factors, including physical activity and sleep, among rural and urban Ugandan youth and relate it to BMI percentile. This survey should be further tested and used to provide a baseline for working with schools to understand the factors associated with weight status in Ugandan youth. Nationally representative studies contextualizing cultural and environmental are necessary to improve nutrition and weight status in a sustainable manner that prevents both under- and overweight.

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