Physical Activity Levels Among Adults in Uganda: Findings From a Countrywide Cross-Sectional Survey

Article *in* Journal of Physical Activity and Health · May 2016

DOI: 10.1123/jpah.2015-0631

Journal of Physical Activity and Health, 2016, 13, 938-945
http://dx.doi.org/10.1123/jpah.2015-0631

Human Kinetics
ORIGINAL RESEARCH

Physical Activity Levels Among Adults in Uganda: Findings From a Countrywide Cross-Sectional Survey

David Guwatudde, Barbara E. Kirunda, Ronald Wesonga, Gerald Mutungi, Richard Kajjura, Hafisa Kasule, James Muwonge, and Silver K. Bahendeka

Background: Being physically active is associated with lower risk of many noncommunicable diseases (NCDs). We analyzed physical activity (PA) data collected as part of Uganda's countrywide NCD risk factor survey conducted in 2014, to describe PA levels in Uganda. **Methods:** PA data were collected on the domains of work, travel and leisure. We calculated the percentage of participants meeting the World Health Organization (WHO) PA recommendations, and the types of intense-specific duration of PA. Prevalence ratios (PR) were used to identify factors associated with meeting WHO PA recommendations. **Results:** Of the 3987 participants, 3758 (94.3%) met the WHO PA recommendations. Work-related PA of moderate intensity, and travel-related PA contributed most to participants' overall weekly duration of PA, each contributing 49.6% and 25.2% respectively. The median weekly duration of all moderate-intensity PA was 1470 minutes (interquartile range [IQR] = 540 to 2460). Weekly duration of all vigorous-intensity PA was low with a median of 0 minutes (IQR = 0 to 1080). The median daily sedentary time was 120 minutes (IQR = 60 to 240). Factors significantly associated with meeting WHO PA recommendations were body mass index and level of education. **Conclusions:** PA levels in Uganda are high, mostly achieved through travel and work-related activities of moderate intensity.

Keywords: WHO physical activity recommendations, non-communicable diseases, WHO STEPs, Uganda, Africa

Chronic noncommunicable diseases (NCDs) are on the rise globally and are currently responsible for two-thirds of the global burden of disease.[1] Projections over the next few decades indicate the largest rise in occurrence of NCDs will be observed in sub-Saharan Africa (SSA).[2] Being physically inactive has been associated with increased risk of a number of NCDs, and is globally responsible for 6% of coronary heart diseases, 7% of type 2 diabetes cases, 10% of breast cancers, and 10% of colon cancers.[3] Furthermore, the global burden of disease study of 2010 showed that globally physical inactivity and low physical activity are together the eleventh leading risk factors for mortality causing 3.2 million global deaths, and more than 69 million disability adjusted life years.[3,4] However, the prevalence of physical inactivity is on the rise worldwide,[2] and is increasingly being recognized as an important public health problem in many low- and middle-income countries.[5]

In SSA countries, there is a general lack of detailed population-based data on levels of physical activity (PA).[6] Few countries in SSA have assessed levels of PA by intensity, distribution among its populations, and differences by the domains of work, travel or leisure, through which PA requirements are achieved. Understanding the distribution of PA in the population and the associated factors across the different domains by intensity is important as this may inform formulation of appropriate policies and/or community-based interventions for promotion and/or maintenance of adequate levels of PA in the general population.[7]

In Uganda, until recently there had been no study aimed at determining levels of PA, their adequacy, and distribution within its population. In 2014, Uganda's Ministry of Health commissioned the first countrywide NCD risk factor survey to provide baseline estimates of the prevalence of the common risk factors for NCDs in the country. Between July and August 2015, we analyzed the self-reported PA data collected in this survey, with the objectives of a) identifying the most important domains of PA (including work, travel, and leisure), through which people in Ugandan achieve PA requirements; b) the duration of PA and sedentary time; c) the percentage of participants meeting the World Health Organization (WHO) PA recommendations; and d) identifying factors associated with meeting WHO PA recommendations.

Methods

A cross-sectional study design was used to conduct the NCD risk factor survey between April and July 2014. The survey used the World Health Organization's (WHO) STEPwise approach to surveillance, a standardized method of analyzing risk factors for NCDs.[8] A detailed description of methods used to conduct the survey has been reported elsewhere.[9,10] Here we only describe methods relevant for results presented in this article.

Sample Size and Sample Selection

The national NCD risk factor survey used a multistage stratified sampling design with the aim of generating a nationally representative sample. The sample size was estimated using a 5% cardiovascular disease prevalence, precision set at 1.5%, a 95% confidence interval, and adjusted for a design effect of 2.0. The sampling procedure used the Uganda Bureau of Statistics (UBOS) master sampling frame of Enumeration Areas (EAs) that had just been demarcated throughout

Guwatudde and Kirunda are with the Dept of Epidemiology and Biostatistics; Wesonga is with the School of Statistics; Kajjura is with the Dept of Community Health and Behavioral Sciences; Makerere University, Kampala, Uganda. Mutungi is with the Control of the Non-Communicable Diseases Desk, Ministry of Health, Kampala, Uganda. Kasule is with the Uganda Country Office, World Health Organization, Kampala, Uganda. Muwonge is with the Division of Socioeconomic Surveys, Uganda Bureau of Statistics, Kampala, Uganda. Bahendeka is with the Dept of Internal Medicine, Nsambya Hospital, Kampala, Uganda. Guwatudde (dguwatudde@musph.ac.ug) is the corresponding author.

the country in preparation for the 2014 population and housing census. The average number of households in the EAs was 77 in rural areas, and 95 in urban areas. To increase representativeness of the various regional ethnic groups in the country, selection was stratified by the 4 regions of the country: central, eastern, northern, and western, with separate estimates for rural and urban areas. In the first stage of selection, a random sample of 350 out of 78,950 EAs in the whole country were selected with selection probability proportional to the size (PPS) of the number of households in the EAs. Trained UBOS staffs were dispatched throughout the country to list the households within the sampled EAs. In the second stage of sampling, 14 households were randomly selected from the listed households in each EA giving a total sample of 4900 households. Finally on the day of the survey, trained interviewers enumerated eligible household members who were recorded in Personal Digital Assistants (PDA), which was then used to randomly select 1 subject from each household for inclusion in the survey. Eligible subjects were household members aged 18 to 69 years, who had resided in the sampled households for at least 6 months preceding the date of the survey.

Measurements

Data were collected using the standard WHO STEPs tool for NCD risk factor surveillance.[8] The tool was translated to 6 commonly spoken local languages in Uganda. To ensure maintenance of the meaning of the questions, the translated questionnaires were back translated to English and corrections made accordingly. Before trained interviewers administered the tool, participants were given the option of being interviewed in any 1 of the 7 languages of their choice, including English.

STEP 1 of the tool collected demographic, socioeconomic, and behavioral characteristics, including PA. Physical activity data were collected using question in the WHO STEPS tool that draws PA questions from the global physical activity questionnaire (GPAQ) developed by WHO in 2002 as part of the WHO STEPwise approach to chronic disease risk factor surveillance.[11] The GPAQ has been found to have moderate to high reliability in a 12 country reliability and validity study.[12] PAs were assessed under the 3 domains of a) work, b) travel, and c) leisure. Under each of these domains, PAs were classified as either "vigorous intensity" if they reportedly caused large increase in breathing and/or heart rate, and if they were done continuously for at least 10 minutes; or classified as "moderate intensity" if they reportedly caused a small increase in breathing and/or heart rate, and if they were done continuously for at least 10 minutes.

To classify the participants' PAs into the different intense-specific PA categories, participants were asked to, for example, think about their typical work and identify if any of their work-related activities require hard physical effort and cause large increases in breathing or heart rate. Showcards were used to help respondents identify the types of PA they engaged in. The showcards showed pictures of examples of the various day-to-day activities in the Ugandan context. The pictures on the showcards had previously been adapted by the investigators and used during the training of the research assistants. If a participant reported to engage in any category of the activities described for at least 10 minutes, the average number of days during which they engaged in such activities would be recorded, as well as the average duration in minutes they spend on such an activity per day. The duration of physical activity by participants reporting not to have had engaged in a specific physical activity category was recorded as 0 minutes. Participants were also asked to provide an estimate of how much time they usually spend on a typical day, sitting or reclining at work and/or at home, including time spent sitting at a desk, sitting with friends, traveling in car, bus, train, reading, playing cards or watching television, but excluding time spent sleeping (sedentary time).

STEP 2 of the tool made physical measurements that included weight, height, and blood pressure, among other physical measurements. Weight and height were later used to calculate the participants' body mass index (BMI). The procedures used to conduct the physical measurements, calculation of BMI, and classification of participants' hypertensive status have been described in detail elsewhere.[9] STEP 3 of the tool made biochemical measurements including fasting plasma glucose (FPG), among other and biochemical measurement. Details of the procedure used to measure FPG have also been described elsewhere.[10]

Statistical Analysis

We calculated the percentage of each type of intense-specific PA contributed to the participant's overall duration of weekly duration of PA. To assess the spread of PA throughout a week, we calculated the average number of days in a typical week on which participants reported to engage in a given intense-specific PA under each domain. Thus under each intense-specific PA, we report the average number of days of a week, and standard deviations (SD), participants reported to engage in the intense-specific PA.

To assess the duration of PA, we calculated the median weekly duration, and the respective interquartile ranges (IQR) of PA under each category. Further, we calculated the median daily duration of sedentary time, and the respective IQR.

WHO recommends that throughout a week, adults should do at least 150 minutes of moderate-intensity PA, or 75 minutes of vigorous-intensity PA or an equivalent combination across all the 3 domains. The recommended time can be achieved through activities for work, travel, and/or leisure.[13] Thus we calculated the percentage of participants that had per week a total duration of at least 75 minutes of the vigorous-intensity PA, or at least 150 minutes of moderate-intensity PA. We also calculated the equivalent combination across all domains of PAs to determine if overall, participants met the WHO PA recommendations. Every 2 minutes of medium-intensity PA were calculated to be equivalent to 1 minute of vigorous-intensity PA.

To identify factors associated with meeting the WHO PA recommendations, the modified Poisson regression model with robust error variance was used to estimate both the crude and adjusted prevalence ratios (PR),[14] with their corresponding 95% confidence intervals (95% CI). The modified Poisson regression model, was preferred to avoid under estimation of the standard errors for the estimated risk ratios that is usually the case with logistic regression modeling when the prevalence of the outcome is greater than 10%.[15,16] A stepwise backward elimination was used to remove variables not significantly associated with meeting the WHO PA recommendations. Variables were removed 1 at a time, starting with those with the largest p-value until only variables significantly associated with meeting the WHO PA recommendations were retained in the model, and/or if removing a variable altered the PR of any of the variables remaining in the model by at least 10%. A 5% level of statistical significance ($\alpha = .05$) was used in identifying factors associated with meeting the WHO PA recommendations.

To adjust for differences in sampling fractions created by different number of sampled participants that actually finally participated in the survey, all median value estimates, prevalence estimates, and the Poisson modeling were weighted using the sampling weights. The sampling weights were calculated as the inverse of the cumulative probabilities of selection at the different stages, (by multiplying the probabilities of selection of the respective EA, with the probability of selection of the subject from within the household among those eligible in the household). All statistical analyses were performed using in STATA software version 13 (StataCorp, College Station, Texas, USA).

Ethics

Ethical approval of the study was obtained from the Institutional Review Committee of Nsambya Hospital, Kampala, Uganda and registered by the Uganda National Council for Science and Technology. Written informed consent was obtained from each participant before conducting any study procedures.

Results

Study Sample

Of the 4900 sampled subjects, 3987 participated in the NCD risk factor survey giving a response rate of 81.4%. The remaining 913 sampled subjects either could not be found at home on repeated visits by the data collection team, had relocated by the time of conducting the survey, or declined to participate. All the 3987 participants in the NCD risk factor survey provided PA data in at least 1 of the PA domains, and were included in this analysis.

Characteristics of Participants

Of the 3987 participants, 2383 (59.8%) were female, 2903 (72.8%) resided in rural areas, 1691 (42.4%) had attained at least secondary school education, 2676 (67.1%) were aged 18 to 39 years, and the overall average age was 35.1 years (SD= 13.1). Table 1 gives a summary of the participants' characteristics.

Table 1 Characteristics of Participants in Uganda's Countrywide NCD Risk Factor Survey Conducted Between April and July 2014

Characteristic	Category	n	Summary measure
All participants		3987	100%
Urban-rural	Urban	1084	27.2%
	Rural	2903	72.8%
Region	Central	1294	32.5%
	Eastern	964	24.2%
	Northern	779	19.5%
	Western	950	23.8%
Sex	Males	1604	40.2%
	Females	2383	59.8%
Age in years	18–19	340	8.5%
	20–29	1322	33.2%
	30–39	1014	25.4%
	40–49	641	16.1%
	≥ 50	670	16.8%
	Mean (SD)	3987	35.1 (13.1)
Level of education attained	None	654	16.4%
	Primary school	1626	40.8%
	Secondary school	1317	33.0%
	University or higher	374	9.4%
	Not stated	16	0.4%
Marital status	Never married	627	15.7%
	Married/ Cohabiting	2644	66.3%
	Separated /Divorced /Widowed	716	18.0%
BMI (kg/m^2)[a]	< 25.0	2863	71.8%
	25.0–29.9	590	14.8%
	≥ 30.0	236	5.9%
	Not stated	298	7.5%
Hypertensive?	No	2873	72.1%
	Yes	1033	25.9%
	Not stated	81	2.0%
FPG (mmol/L)[b]	< 6.1	3563	89.4%
	6.1–6.9	82	2.1%
	≥ 7.0, or on DM Rx[e]	46	1.2%
	Not stated	296	7.4%

[a] BMI = Body Mass Index in kilograms per squared meters (kg/m^2); [b] FPG = Fasting plasma glucose in millimoles per liter (mmol/L).

Participant's Volume of Intense-Specific PA

The type of intense-specific PAs found to contribute most to participants' overall weekly PA were from work-related PA of moderate intensity contributing 49.6% of participants' overall weekly PA, followed by travel-related PA contributing 25.2%, and work-related PA of vigorous intensity at 19.8%. Figure 1 summarizes the percentage contribution of the different types of participants' intense-specific PA to their overall weekly physical activities.

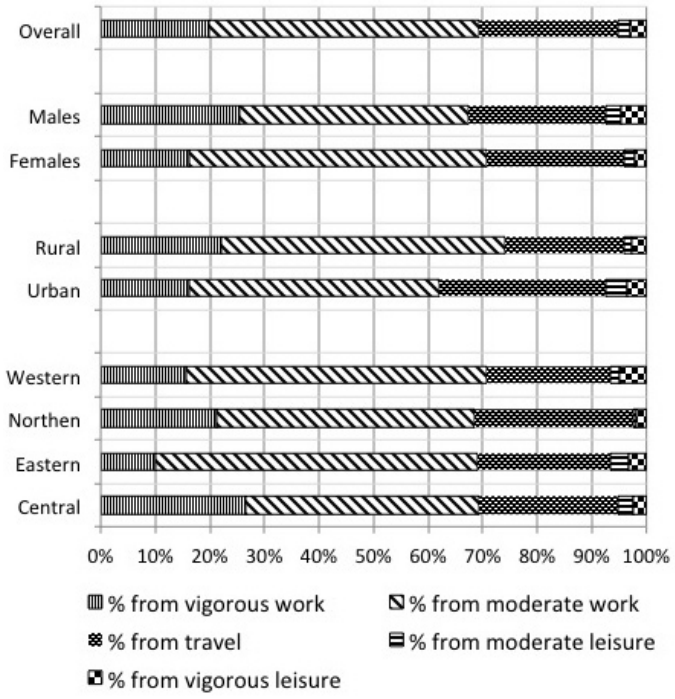

Figure 1 — Percentage contribution of various intense-specific physical activities to weekly duration of physical activities in Uganda's countrywide NCD risk factor survey.

Average Number of Days in a Week, Participants Engage in Intense-Specific PA

The intense-specific PA in which participants reported to engage in most days of a typical week were travel-related PA with an average of 4.5 (SD = 2.6) days per week, and work-related PA of moderate intensity with an average of 4.5 (SD = 3.3) days per week. Participants also reported to engage in work-related PA of vigorous intensity on an average of 2.1 (SD = 2.8) days per week. The average number of days on which leisure-related PA were done was less than 1 day. Figure 2 gives a summary of the average number of days per a typical week during which they engage in the intense specific PA.

Duration of PA and Sedentary Time

The intense-specific PA in which participants engaged in longest were work-related PA of moderate intensity, with a median weekly duration of 990 (IQR = 150, 1800) minutes, followed by travel-related PA with a median weekly duration of 240 (IQR = 70, 600) minutes. The weekly duration of PA in the other 3 intense-specific PAs, that is, work-related of vigorous intensity, leisure of both vigorous and moderate intensity was very low, all with a median weekly duration of 0 minutes. The overall median duration of sedentary time per day was 120 (IQR = 60, 240) minutes. Table 2 summaries the weekly duration of the intense-specific PA, and the daily duration of sedentary time.

Meeting WHO PA Recommendations

The majority of participants, 77.4% (3289 out of 3899) met WHO PA recommendations through travel-related PA alone. The next type of PA through which most participants met the WHO PA recommendations were work-related PA of moderate intensity, 82.4% (3261 out of 356). Less than 50% of participants achieved WHO PA recommended levels through any 1 of the remaining 3 types of intense-specific PA. Overall however, 94.3% (3758 out of 3987) met the WHO PA recommendations. Table 3 summaries the percentages of participants meeting the WHO PA recommendations through each of the domains of PA.

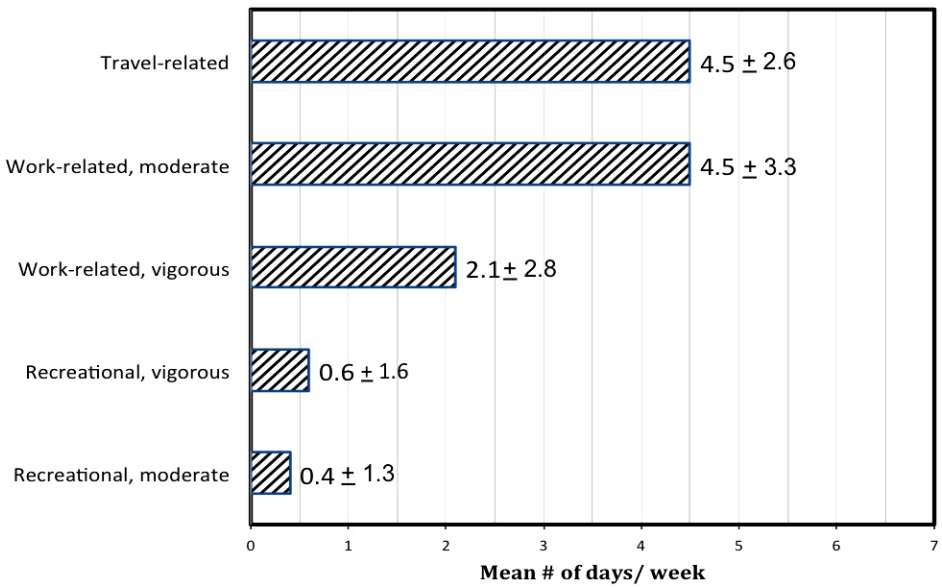

Figure 2 — Average number of days in a week (± SD) during which participants engage in intense-specific physical activities in Uganda's countrywide NCD risk factor survey.

Table 2 Duration of Physical Activities and Sedentary Time for Participants in Uganda's Countrywide NCD Risk Factor Survey Conducted Between April and July 2014

Type of intense-specific physical activities	n	Median duration in minutes (IQR[a])
Work-related vigorous/week	3959	0 (0–1080)
Work-related moderate/week	3956	990 (150–1800)
Travel-related/week	3899	240 (70–600)
Leisure vigorous/week	3968	0 (0–0)
Leisure moderate/week	3973	0 (0–0)
All moderate combined/week	3965	1470 (540–2460)
All vigorous combined/week	3981	0 (0–1080)
Sedentary time/day	3821	120 (60–240)

[a] IQR= Inter-quartile range.

Table 3 Proportion of Participants That Met the WHO PA Recommendations, by Type of Intense-Specific Physical Activity

Type of intense-specific physical activity	n	# meeting WHO PA recommendations[a]	% meeting WHO PA recommendations (95% CI)[b]
Work related- vigorous	3959	1517	38.1 [36.2–40.1]
Work related- moderate	3956	3060	75.0 [73.2–76.9]
All work related combined	3978	3431	83.7 [82.1–85.4]
Travel related	3899	2554	63.3 [61.3–65.4]
Leisure- vigorous	3968	551	12.7 [11.5–14.0]
Leisure- moderate	3973	268	7.3 [6.2–8.4]
All leisure related combined	3979	694	17.0 [15.6–18.5]
All vigorous across all domains	3981	1653	40.9 [38.9–42.9]
All moderate across all domains	3965	3626	90.6 [89.4–91.9]
Equivalent of combination across all types	3987	3758	93.3 [92.2–94.4]

[a] At least 75 minutes of vigorous intensity, or 150 minutes of moderate intensity, or equivalent of a combination; [b] Weighted percentages using sampling weights.

Factors Associated With Meeting WHO PA Recommendations

Two factors were found to be significantly associated with meeting the WHO PA recommendations, including body mass index (BMI), and level of education. Compared with participants with BMI < 25 kg per square meter (kg/m^2), obese participants (BMI ≥ 30 kg/m^2) were less likely to meet the WHO PA recommendations, with an adjusted PR of 0.92 [95% CI = 0.85 to 0.99]. Also compared with participants reporting no schooling, participants with university education or higher were less likely to meet the WHO PA recommendations, with an adjusted PR of 0.95 [95% CI = 0.90 to 0.99].

The other factors examined in our analysis but found not to be significantly associated with meeting the WHO PA recommendations were urban-rural and region of residence, sex, age, blood pressure level status, fasting plasma glucose level status, marital status, and ethnicity. Table 4 summarizes the association analysis results.

Discussion

Our study reveals high levels of PA among the population in Uganda, with 94.3% of the participants meeting the WHO PA recommendations. There is scantly published literature on levels of PA in sub-Saharan African (SSA). In Uganda, we found only 1 published study that reported the percentage of the study population that met WHO PA recommendations. The study was conducted in 2 rural districts of Uganda that assessed PA using a similar tool, in which 85.4% of participants met WHO PA recommendations.[17] Two other studies conducted in the western and southern districts of Kasese[18] and Masaka,[19] respectively, reported aggregated data of "low physical activity," making comparison with our study impossible. Surveys conducted in 22 SSA countries also showed high levels of PA, in which most, more than 80% of participants, met the WHO PA recommendations.[6]

Worth noting from our study is that most participants were able to achieve the WHO PA recommendations through travel- or work-related PA of moderate intensity alone. The majority of the population in Uganda rely predominantly on physical transportation like walking and cycling (travel-related), and engage in labor-based agriculture (work-related) as the main source of livelihood that promote PA. Thus the high levels of PA are partly a reflection of these population characteristics in Uganda.

Sedentary time in this adult population was low. Similar findings have been made in other SSA countries in World Health Surveys conducted in Malawi, Burkina Faso, Ghana, Kenya, Cote d'Ivoire, Mali, and Senegal.[20] Given the high levels of PA

Table 4 Prevalence Ratios (PR) for Meeting WHO PA Recommendations Among Participants in Uganda's Countrywide NCD Risk Factor Survey Conducted Between April and July 2014

Characteristic	n	# meeting WHO PA recommendations (%)	Crude PR [95% CI]	Adjusted PR [95% CI][a]
Urban-rural				
Rural	2903	2770 (95.4%)	1.00	1.00
Urban	1084	998 (91.1%)	0.96 [0.93–0.98]	0.97 [0.94–1.01]
Region				
Northern	779	753 (96.7%)	1.00	1.00
Central	1294	1189 (91.9%)	0.96 [0.93–0.99]	0.97 [0.93–1.01]
Eastern	964	898 (93.2%)	0.97 [0.94–1.01]	0.98 [0.95–1.01]
Western	950	918 (96.6%)	1.01 [0.98–1.04]	1.01 [0.98–1.05]
Sex				
Females	2383	2227 (93.4%)	1.00	1.00
Males	1604	1531 (95.5%)	1.02 [1.00–1.05]	1.03 [1.00–1.06]
BMI (kg/m^2)				
< 25.0	2863	2722 (95.1%)	1.00	1.00
25.0–29.9	590	553 (93.7%)	0.96 [0.93–1.00]	0.97 [0.93–1.01]
≥ 30.0	236	204 (86.4%)	0.91 [0.85–0.98]	0.92 [0.85–0.99]
Age (years)				
18–19	340	327 (96.2%)	1.00	1.00
20–29	1322	1244 (94.1%)	1.00 [0.95–1.05]	1.01 [0.95–1.07]
30–39	1014	967 (95.4%)	1.01 [0.96–1.06]	1.01 [0.95–1.07]
40–49	641	609 (95.0%)	1.01 [0.96–1.07]	1.01 [0.96–1.07]
≥50	670	611 (91.2%)	0.97 [0.92–1.03]	0.97 [0.92–1.04]
Level of education				
None	654	619 (94.7%)	1.00	1.00
Primary school	1626	1563 (96.1%)	1.00 [0.98–1.03]	1.00 [0.97–1.03]
Secondary school	1317	1223 (92.9%)	0.97 [0.94–1.00]	0.97 [0.94–1.00]
University or higher	374	340 (90.9%)	0.94 [0.89–1.00]	0.95 [0.90–0.99]
Hypertensive				
No	2873	2722 (94.7%)	1.00	1.00
Yes	1033	963 (93.2%)	0.98 [0.95–1.01]	0.99 [0.96–1.02]
FPG (mmol/L)[b]				
< 6.1	3563	3364 (94.4%)	1.00	1.00
6.1–6.9	82	78 (95.1%)	1.01 [0.95–1.08]	1.03 [0.96–1.09]
≥ 7.0, or on DM Rx[c]	46	42 (91.3%)	0.99 [0.90–1.09]	0.99 [0.89–1.10]

[a] Adjusted for BMI and level of education; [b] PG = Fasting plasma glucose in millimoles per liter (mmol/L); [c] DM Rx = Diabetes Mellitus Treatment.

and low sedentary time, physical inactivity may at the present time not be a key contributing factor toward NCD occurrence in Uganda. Indeed previous comparative studies have shown that the prevalence of physical inactivity is more prevalent in high income countries than in low income countries.[5] Nonetheless there is a need to develop a comprehensive policy to promote and maintain the high levels of PA observed in our study, as part of a general strategy for prevention of chronic NCDs. This is especially so as urbanization increases, which has been associated to changes toward unhealthy life styles, including physical inactivity.[21–23] Promotion of PA among young people, for example in schools, could provide a good opportunity that may increase chances of inculcating a culture of maintaining adequate levels of PA in the general population.

We also found that participants performed their PAs on an average of 4.5 days per week. Our findings indicate that PAs were fairly well spread out in a week. There is absence of published literature in SSA countries on the spread of PA through the week thus it was not possible to make any comparisons with other SSA countries. WHO does not only recommend at least 75 minutes of vigorous intensity, or at least150 minutes of moderate intensity, but that such PAs should be spread throughout the week.[13]

We identified only 2 factors associated with meeting WHO PA recommendations, including BMI and level of education. Other

factors that have previously been found to be associated with meeting WHO PA recommendation like age,[24] urbanicity,[25] or sex,[26–28] were not significant. It is possible that indeed these factors do not at the present moment determine differences in PA levels in the population in Uganda. However, given the nearly 100% prevalence of persons meeting WHO PA recommendations, there was little variation in levels of PA, which limits the ability to identify factors that could be associated with meeting WHO PA recommendations.

Strengths and Limitations

Our study has a number of strengths. First, the study used the widely used and validated GPAQ tool, and used standardized methods like use of showcards to collect PA data. Our findings provide country-wide representative detailed data on PA among adults in Uganda, which can be used as a benchmark for monitoring PA trends and evaluate efforts to promote and/or sustain PA levels at population level, as well as improve relevant health promotion public health policies. Many low income countries, including sub-Saharan Africa still lack data on levels of PA in their populations.[5] Second, our study provides a detailed analysis including: types of domain intense-specific PA, duration of the PA in a week, spread of the PA in a week, and the percentage of participants meeting the WHO PA recommendations. All this is important benchmark information that can be used for monitoring PA levels and/or evaluating PA interventions in the population. Based on published literature, this kind of detailed analysis is still lacking in most of the SSA countries.

Our study has 2 important limitations. First, the study is based self-reported physical activity, which has been found to overestimate duration of PA when compared with objective measures of PA in studies conducted in the USA, Sweden, and the UK.[29–31] The estimated durations of PA may also have been difficult in minutes, than maybe in hours, particularly in rural populations where estimation of time is not usually particularly precise as compared with urban populations. It is therefore possible that the levels of PA reported from our analysis might be higher than in reality. However objective methods of measuring PA may not only be expensive, the feasibility of accurately applying this widely in the SSA setting, such as those used in Cameroon,[22,32] may need to be assessed first.

Conclusions

Overall, this predominantly rural adult population in Uganda is highly physically active and most meet the WHO PA recommendations through transportation and occupational activities of moderate-intensity. Further inquiry on correlates of different domains of PA and other correlates such as socioeconomic, cultural and environmental factors are needed to further understand the levels and patterns of PA in the Ugandan population.

Acknowledgments

The authors acknowledge the research participants who volunteered to participate in the NCD risk factor prevalence survey; and for the technical and administrative support provided by Uganda's Ministry of Health, and from the Uganda Bureau of Statistics. The authors also acknowledge the technical support provided by Melanie Cowan and Lubna Ishaq Bhatti of the Surveillance and Population-based Prevention Unit, Department of Prevention of Non-communicable Diseases, World Health Organization, Geneva, Switzerland. The conduct of the NCD Risk Factor Survey was supported by funding from the Uganda government, the World Health Organization, the World Diabetes Foundation, and the United Nations Development Program.

References

1. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380(9859):2095–2128. doi:10.1016/S0140-6736(12)61728-0 PubMed
2. WHO. WHO | Projections of mortality and causes of death, 2015 and 2030. *WHO Website*. 2013. http://www.who.int/healthinfo/global_burden_disease/projections/en/. Accessed February 3, 2016.
3. Lee I-M, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet*. 2012;380(9838):219–229. doi:10.1016/S0140-6736(12)61031-9 PubMed
4. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380(9859):2224–2260. doi:10.1016/S0140-6736(12)61766-8 PubMed
5. Guthold R, Ono T, Strong KL, Chatterji S, Morabia A. Worldwide variability in physical inactivity a 51-country survey. *Am J Prev Med*. 2008;34(6):486–494. doi:10.1016/j.amepre.2008.02.013 PubMed
6. Guthold R, Louazani SA, Riley LM, et al. Physical activity in 22 African countries: results from the World Health Organization STEPwise approach to chronic disease risk factor surveillance. *Am J Prev Med*. 2011;41(1):52–60. doi:10.1016/j.amepre.2011.03.008 PubMed
7. Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJF, Martin BW. Correlates of physical activity: why are some people physically active and others not? *Lancet*. 2012;380(9838):258–271. doi:10.1016/S0140-6736(12)60735-1 PubMed
8. WHO. WHO | STEPwise approach to surveillance (STEPS). *WHO Website*. 2009. http://www.who.int/chp/steps/en/. Accessed April 12, 2015.
9. Guwatudde D, Mutungi G, Wesonga R, et al. The epidemiology of hypertension in Uganda: findings from the National Non-Communicable Diseases Risk Factor Survey. *PLoS One*. 2015;10(9):e0138991. doi:10.1371/journal.pone.0138991 PubMed
10. Bahendeka S, Wesonga R, Mutungi G, Muwonge J, Neema S, Guwatudde D. Prevalence and correlates of diabetes mellitus in Uganda: a population-based national survey. *Trop Med Int Health*. 2016;21(3):405-16. doi:10.1111/tmi.12663 PubMed
11. WHO. WHO | Global Physical Activity Surveillance. *WHO Website*. 2002. http://www.who.int/chp/steps/GPAQ/en/. Accessed February 10, 2016.
12. Craig CL, Marshall AL, Sjöström M, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*. 2003;35(8):1381–1395. doi:10.1249/01.MSS.0000078924.61453.FB PubMed
13. WHO. Global recommendations on physical activity for health. *WHO Website*. 2010. http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf. Accessed July 21, 2015.
14. Zou G. A modified Poisson regression approach to prospective studies with binary data. *Am J Epidemiol*. 2004;159(7):702–706. PubMed doi:10.1093/aje/kwh090
15. Diaz-Quijano FA. A simple method for estimating relative risk using logistic regression. *BMC Med Res Methodol*. 2012;12:14. doi:10.1186/1471-2288-12-14 PubMed
16. McNutt L-A, Wu C, Xue X, Hafner JP. Estimating the relative risk in cohort studies and clinical trials of common outcomes. *Am J Epidemiol*. 2003;157(10):940–943. PubMed doi:10.1093/aje/kwg074
17. Mayega RW, Guwatudde D, Makumbi F, et al. Diabetes and prediabetes among persons aged 35 to 60 years in eastern Uganda:

prevalence and associated factors. *PLoS One*. 2013;8(8):e72554. doi:10.1371/journal.pone.0072554 PubMed
18. Mondo CK, Otim MA, Akol G, Musoke R, Orem J. The prevalence and distribution of non-communicable diseases and their risk factors in Kasese district, Uganda. *Cardiovasc J Afr*. 2013;24(3):52–57. doi:10.5830/CVJA-2012-081 PubMed
19. Murphy GA, Asiki G, Ekoru K, et al. Sociodemographic distribution of non-communicable disease risk factors in rural Uganda: a cross-sectional study. *Int J Epidemiol*. 2013;42(6):1740–1753. doi:10.1093/ije/dyt184 PubMed
20. WHO. WHO Global InfoBase. *WHO Website*. 2003. https://apps.who.int/infobase/Indicators.aspx. Accessed November 10, 2015.
21. Ng SW, Howard A-G, Wang HJ, Su C, Zhang B. The physical activity transition among adults in China: 1991-2011. *Obes Rev*. 2014;15(Suppl 1):27–36. doi:10.1111/obr.12127 PubMed
22. Assah F, Mbanya JC, Ekelund U, Wareham N, Brage S. Patterns and correlates of objectively measured free-living physical activity in adults in rural and urban Cameroon. *J Epidemiol Community Health*. 2015;69(7):700–707. doi:10.1136/jech-2014-205154 PubMed
23. Assah FK, Ekelund U, Brage S, Mbanya JC, Wareham NJ. Urbanization, physical activity, and metabolic health in sub-Saharan Africa. *Diabetes Care*. 2011;34(2):491–496. doi:10.2337/dc10-0990 PubMed
24. Muntner P, Gu D, Wildman RP, et al. Prevalence of physical activity among Chinese adults: results from the International Collaborative Study of Cardiovascular Disease in Asia. *Am J Public Health*. 2005;95(9):1631–1636. doi:10.2105/AJPH.2004.044743 PubMed
25. Zaman MM, Bhuiyan MR, Karim MN, et al. Clustering of non-communicable diseases risk factors in Bangladeshi adults: An analysis of STEPS survey 2013. *BMC Public Health*. 2015;15:659. doi:10.1186/s12889-015-1938-4 PubMed
26. Kim HK, Kim MJ, Park CG, Kim HO. Gender differences in physical activity and its determinants in rural adults in Korea. *J Clin Nurs*. 2010;19(5-6):876–883. doi:10.1111/j.1365-2702.2009.03054.x PubMed
27. Makai A, Füge K, Breitenbach Z, et al. Gender differences in physical activity of Hungarian adults: an observatory survey. *Value Health*. 2015;18(7):A555. doi:10.1016/j.jval.2015.09.1792 PubMed
28. Augestad LB. Prevalence and gender differences in eating attitudes and physical activity among Norwegians. *Eat Weight Disord*. 2000;5(2):62–72. PubMed doi:10.1007/BF03327481
29. Slootmaker SM, Schuit AJ, Chinapaw MJ, Seidell JC, van Mechelen W. Disagreement in physical activity assessed by accelerometer and self-report in subgroups of age, gender, education and weight status. *Int J Behav Nutr Phys Act*. 2009;6:17. doi:10.1186/1479-5868-6-17 PubMed
30. Hagströmer M, Oja P, Sjöström M. Physical activity and inactivity in an adult population assessed by accelerometry. *Med Sci Sports Exerc*. 2007;39(9):1502–1508. doi:10.1249/mss.0b013e3180a76de5 PubMed
31. Troiano RP, Berrigan D, Dodd KW, Mâsse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*. 2008;40(1):181–188. doi:10.1249/mss.0b013e31815a51b3 PubMed
32. Assah FK, Ekelund U, Brage S, et al. Predicting physical activity energy expenditure using accelerometry in adults from sub-Sahara Africa. *Obesity (Silver Spring)*. 2009;17(8):1588–1595. doi:10.1038/oby.2009.39 PubMed