Prevalence and disparities in adolescents' sedentary behaviour from 23 African countries: Evidence from WHO Global school-based Student Health Survey

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Abstract

Objectives: Studies on sedentary behaviour among adolescents in Africa are limited, hindering public health initiatives. The aim of this study was to examine the prevalence, age, gender, country's income level and sub-regional disparities of sedentary behaviour among adolescents in Africa.

Study design: Cross sectional.

Methods: Adolescents who participated in the Global school-based Student Health Survey from the 23 participating African countries were included in the study. Sedentary behaviour was assessed with a self-reported questionnaire. A meta-analysis using random effect modelling was used to estimate the prevalence, age, gender, country's income level and sub-regional disparities of sedentary behaviour.

Results: 63635 adolescents (12 to 17 years) were included in the analysis. The prevalence of sedentary behaviour was significantly among adolescents in Southern Africa and East Africa compared to adolescents in West Africa and North Africa ($Q = 25.15$; $p < 0.001$). No disparities were found for age ($Q = 1.51$; $p = 0.22$), gender ($Q = 0.10$; $p = 0.75$), country's income level ($Q = 4.37$; $p = 0.11$), and survey year ($Q = 1.03$; $p = 0.31$). Results were heterogeneous between countries.

Conclusions: The results suggest that a significant proportion of adolescents in Africa engage in sedentary behaviour, with highest prevalence found in Southern Africa and East Africa. This highlights the need for context-specific policy design and interventions to increase physical activity engagement and limit sedentary behaviour among adolescents in Africa.

Keywords: Adolescents, Africa, Gender, Global School Health Survey, Sedentary behaviour.

Implications and contribution

A significant prevalence of sedentary behaviour was found, with higher estimates among adolescents in Southern Africa and East Africa compared to West Africa and North Africa. This highlights the need to embed the foundation for lifelong reduced sedentary behaviour at the early stages of life to reduce associated burden of non-communicable diseases in Africa.

Introduction

Globally, lifestyles are changing due to economic, educational, cultural and technological developments, resulting in an increase in sedentary behaviour.[1] Sedentary behaviour is an independent predictor of cardiometabolic diseases including type 2 diabetes and cardiovascular disease even in individuals who engage in recommended levels of physical activity.[2] An estimated 6-10% of non-communicable diseases and 9% of premature mortality are linked to sedentary behaviour.[3] Sedentary behaviour refers to any activity (i.e., sitting, lying down, watching television, and other types of screen-based activity) that entails an energy expenditure of ≤1.5 metabolic equivalent units.[4] The adolescent period is more susceptible to take risks that effect their health and are the most sedentary of pediatric populations, with 57% of their after-school period spent being sedentary.[5-8]

Conversely, a dose-response relation between increased sedentary behaviour and health risk in adolescents has been reported. The evidence indicate that leisure time sedentary behaviour is related to negative health outcomes such as increased depressive symptoms, unfavorable body composition, cardiovascular risk factors, poor physical fitness, lower self-esteem, and lower quality of life in adolescents.[9-11] This association is generally stronger for recreational screen time as the specific exposure variable than for total sedentary time in adolescents.[12,13] Consequently, sedentary behaviour guidelines recommend that adolescents should restrict their leisure time sedentary behaviour to less than two hours per day and minimize prolonged sitting.[14-16] An estimated 18-51% of adolescents in Africa engage in leisure time sedentary behaviour and sedentary behaviour is associated with negative health risks such as overweight, obesity and depressive symptoms among adolescents in Africa.[17-20]

Accelerated urbanization processes, globalisation, and changes in lifestyles has led to physical activity transition and resulting sedentary behaviour of the African population, whose cultural,

socioeconomic activities and unique characteristics was previously endowed by a very active lifestyle compared to the rest of the world.[1,21] In the past, education activities took place in outdoors especially in the African rural settings, characterized by physical engagement, and adolescents spent long hours outdoors in active physical activities. Regrettably, this is now characterized by sedentary behaviour partly due to the influx of accessible labour-saving devices and facilities especially in the African urban settings that have flooded the lives of adolescents, with affluence linked to sedentary behaviour among adolescents in Africa.[1,20,22,23]

Conversely, studies exploring the impact of economic development and sedentary behaviours among adolescents have been inconclusive.[24] While some studies show a positive association between sedentary behaviour and country's economic growth[25,26] others found a negative or no association.[27,28] Literature indicates there is increasing levels of sedentary behaviour among in-school adolescents, and many do not engage in recommended levels of physical activity, in the developing world.[1,29] Additionally, it is reported that one in every four adolescents engaged in leisure time sedentary behaviour, in the developing world.[30]

The increasing levels of sedentary behaviour coupled with the growing burden of non-communicable diseases in Africa, and the known association between sedentary behaviour and non-communicable diseases, presents a public health challenge in Africa. Unfortunately, there is limited research regarding sedentary behaviour during adolescence in Africa,[31,32] making it challenging to estimate the burden of sedentary behaviour in the region and develop context-specific recommendations. The very few available studies on sedentary behaviour in Africa used small sample sizes and were limited to small geographical areas, predominantly South Africa.[23,29,32,33]

Understanding the prevalence of sedentary behaviour among adolescents in Africa is important to inform policy decisions and help guide intervention development and implementation to

enhance adolescents present health and improve their health over the life course, as it been evident that adolescence sedentary behaviour continues, and in some instances increase in adulthood.[34-36] The aim of this study was thus to examine the prevalence of leisure time sedentary behaviour, and age, gender, country's income level and sub-regional disparities among adolescents from countries in Africa that participated in the Global school-based Student Health Survey (GSHS).[37] We hypothesized that there would be age, gender, country's economic growth and sub-region differences in sedentary behaviour, based on previous literature.[38,39]

Methods

Data source and study design

The Global school-based Student Health Survey (GSHS)[37] is an observational study of health behaviour and risk factors among schoolchildren and young people. The survey was developed through a collaboration of WHO and the US Centers for Disease Control and Prevention, who together provided technical support to participating countries across the stages of study planning, data collection, and preliminary data analysis. Detailed methodology is described elsewhere in literature https://www.who.int/teams/noncommunicable-diseases/surveillance/systems-tools/global-school-based-student-health-survey/methodology).

In summary, the GSHS used a two-stage cluster sample design to gather data that was typical of all the students in the chosen schools within the participating countries. In the stage one, schools were selected with probability proportional to size sampling, and in the stage two a random selection of classrooms took place within each selected school. All students in the randomly selected classrooms were eligible to participate in the survey. Data collection using self-administer questionnaires was performed during one regular class period. The sedentary

behaviour multiple-choice questionnaire was translated into the local language in each participating country. Responses were completed on computer scannable sheets.

The standardization of survey methodology and content enables comparisons of GSHS-participating countries. Ethical approval was obtained from the national government administration (Ministry of Health and/or Education) and an institutional ethics and/or protocol review committee of each participating country. Both verbal and written consents were obtained from all participants (students, children), their parents, and/or the school officials. Participants confidentiality was ensured through anonymity of the data. Data were weighted for non-response and probability selection.

Twenty-three nationally representative datasets from Africa included the variables used in the current analysis. The GSHS question and wording on sedentary behaviour was the same during the data collection period of the included countries. Some countries such as Egypt provided datasets from more than one survey, and for those countries, we chose only the most recent dataset. Ghana provided separate data files for junior and senior high schools; for of this country, we created a single national data file by merging the two data sets. The survey's response rate for each country ranged from 98% in Algeria to 69% in Uganda. The characteristics of each country's survey are provided in Table 1.

Measure

Sedentary behaviour

Sedentary behaviour was measured by a single question**, '***How much time do you spend during a typical or usual day sitting and watching television, playing computer games, talking with friends, or doing other sitting activities country, such as COUNTRY SPECIFIC EXAMPLES?***'**

The following prompt preceded the question to prime students to consider only non-classroom-based sitting in their response: 'The next question asks about the time you spend mostly sitting when you are not in school or doing homework'.

The responses varied between less than 1 hour per day and more than 8 hours per day. In accordance with previous studies, sedentary behaviour was defined as daily sitting time of greater than two hours[7,15,40] and the variable was dichotomized (≥2 hours/day or not) in this study.

Socio-demographic and economic variables

The sociodemographic variables included age, sex, and country's income level. These variables are available in the GSHS dataset and were selected based on previous literature.[9,26,27,38] Countries' income level was based on United Nation classifications.[41] Countries' economic status were categories as low-income countries, lower-middle income countries, upper-middle income countries, and high-income counties based on countries' status at the time of data collection.

Statistical analysis

The socio-demographic and economic data were described and characterized using descriptive statistics such as frequencies, tables, and percentages. Meta-analysis using random-effect modelling was used to estimate the prevalence of sedentary behaviour (overall and age, gender, country-income level and sub-region disparities) as described by DerSimonian and Laird[42]. Heterogeneity was visually inspected using the forest plot and quantified using the Higgins's[43] I^2 statistic to assess the level of between-country heterogeneity and explored by conducting subgroup analyses for age (12-14 years vs. 15-17 years), gender (male vs. female), income level (low-income vs. lower-middle income vs. upper-middle income) and sub-region (Southern Africa vs. East Africa vs. North Africa vs. West Africa). A value of <40% is often

considered as negligible and 40–60% as moderate heterogeneity.[43] Missing data in the survey were not analyzed. The prevalence of sedentary behaviour, as well as age, gender, countries' income level and sub-region differences were assessed using proportions with 95% confidence intervals and visually represented on forest plots. All analyses were conducted using STATA (Stata Statistical Software: Release 16; College Station, TX; Stata Corp LP).

Results

Sample characteristics.

63635 adolescents aged 12 to 17 from twenty-three African countries were included in this study. The sample size varied from 1576 in Benin to 6368 in Morocco. There was 2412 missing data, ranging from 9 in Benin to 322 in Kenya. Majority were females (50%) and middle adolescents, 15-17years (53%). The percentage of female participation peaked in Seychelles (54%) and fell to its lowest in Sudan (18%). For the included countries, the survey was conducted between 2003 and 2017, and consisted of ten low-income, seven lower middle-income, and six upper middle-income countries. Furthermore, the included countries consisted of three Southern African, five West Africa, six North Africa and nine East Africa countries.

Insert table 1 near here

Prevalence and distribution of sedentary behaviour

Figure 1 shows the prevalence of sedentary behaviour among adolescents in the included countries. The estimated prevalence of sedentary behaviour was 30% (95% CI: 27%-34%). In terms of country specific estimates, sedentary behaviour was most prevalent in Seychelles 51%, (95% CI: 47%-55%), followed by Zimbabwe 45%, (95% CI: 41%-50%), and Mauritius 40% (95% CI: 37%-44%). The prevalence was least in Liberia 20%, (95% CI: 16%-24%), and Sudan 20%, (95% CI: 15%-24%).

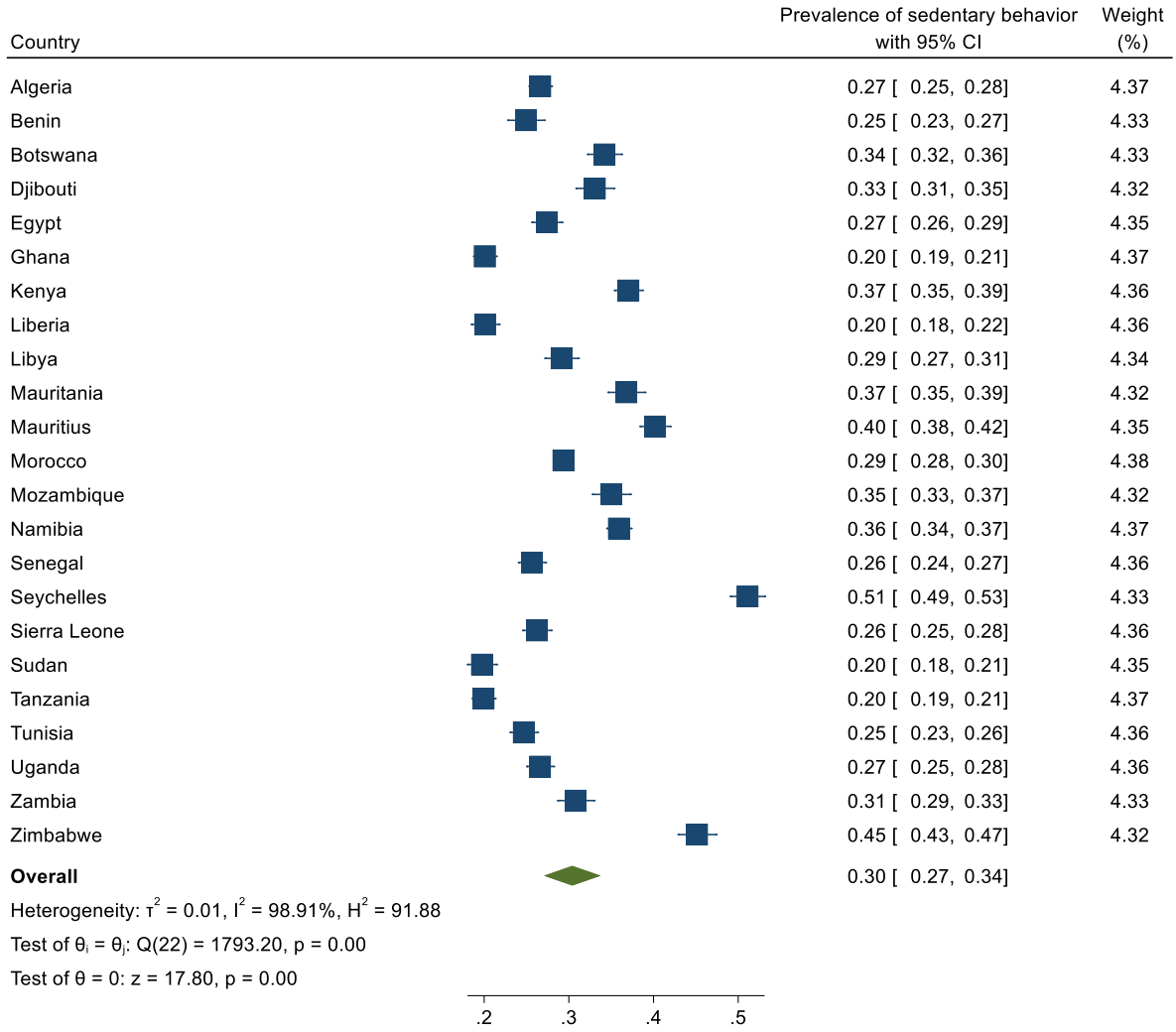

Figure 1: Prevalence of sedentary Behavior among adolescents in Africa.

The age disparity in sedentary behaviour is shown Figure 2. 31% (95% CI: 28%-34%) and 30% (95% CI: 26%-34%) of early adolescents (12-14 years) and middle-aged adolescents (15-17 years) respectively engaged in sedentary behaviour.

Test of between group difference revealed no significant difference between middle-aged adolescents and early adolescents (Q = 1.51; p = 0.22).

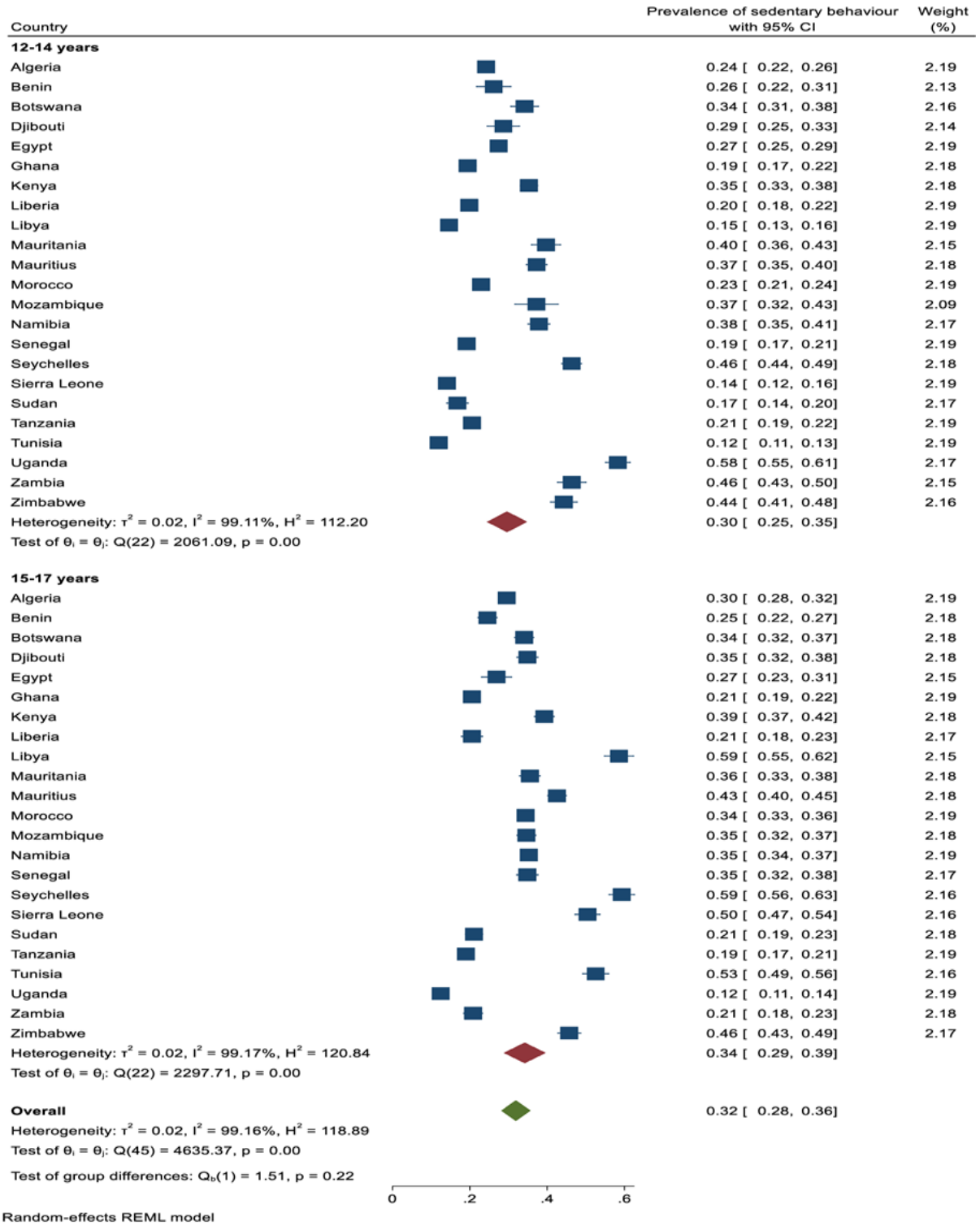

Figure 2: Prevalence of sedentary Behavior among adolescents stratified by age.

The distribution of sedentary behaviour according to gender is illustrated in Figure 3. 31% (95% CI: 28%-34%) males and 30% (95% CI: 26%-34%) of females engaged in sedentary behaviour.

There was no significant difference between the males and females (Q = 0.10; p = 0.75).

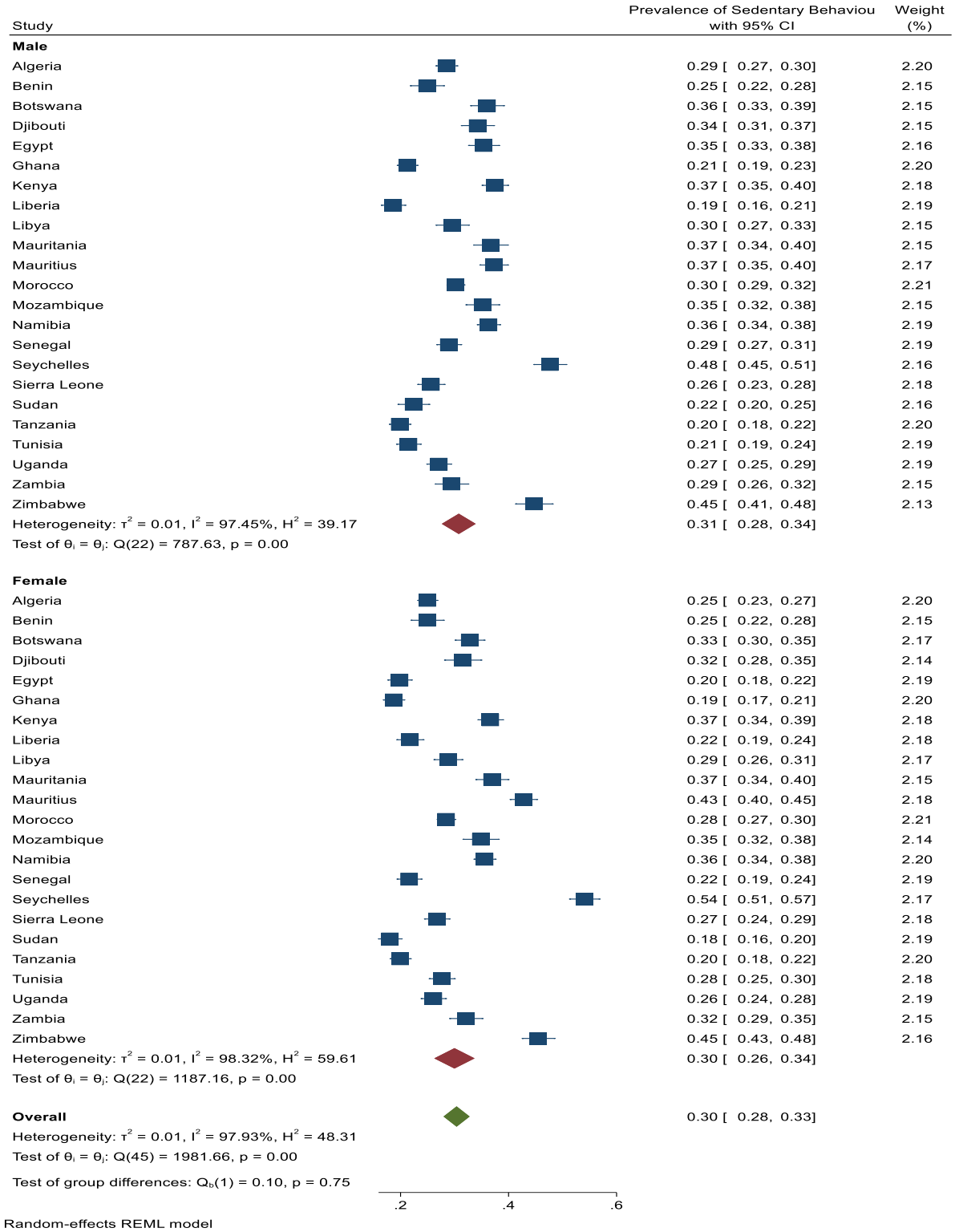

Figure 3: Prevalence of sedentary Behavior among adolescent stratified by sex.

Prevalence of sedentary behaviour stratified by income level, sub-region and survey year

Figure 4 shows the results of the prevalence of sedentary behaviour by country's income level, sub-region and survey year.

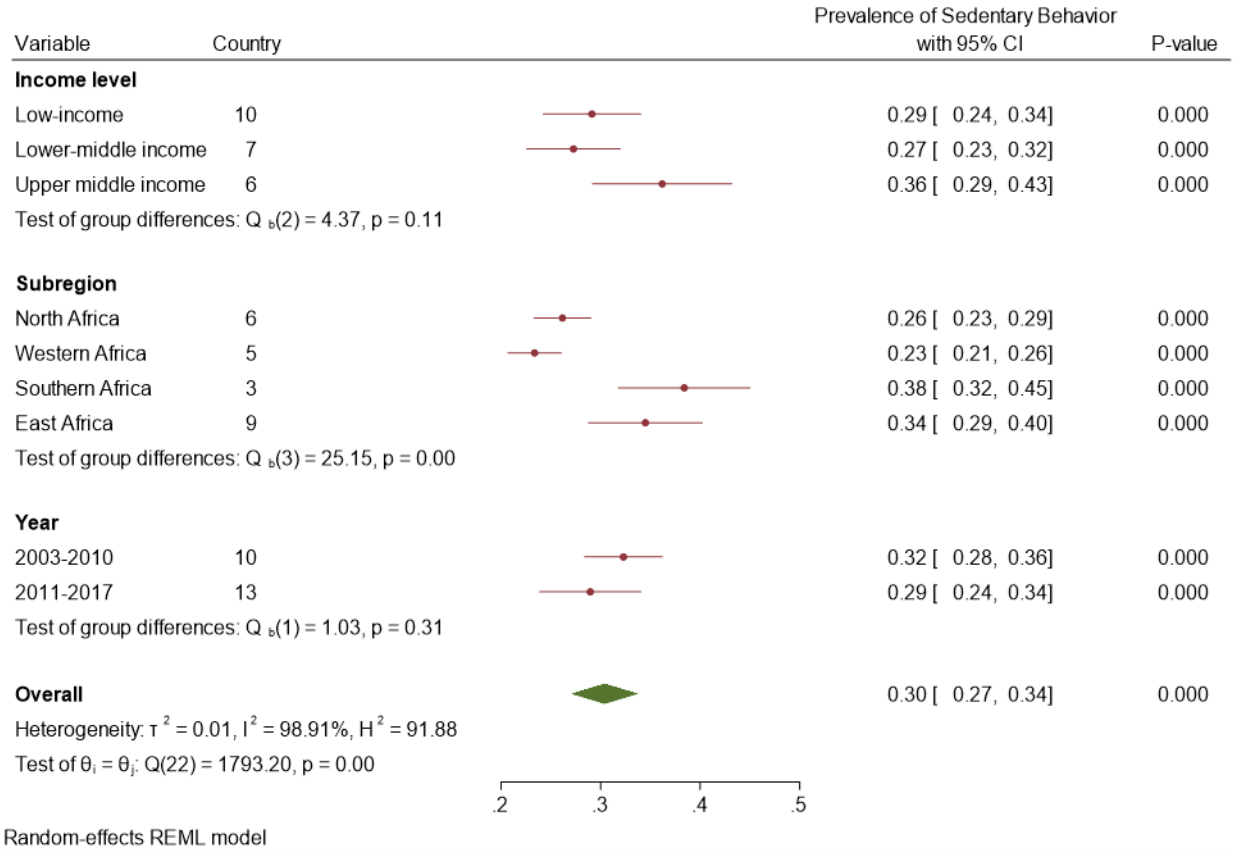

Figure 4: Prevalence of sedentary Behavior among adolescents stratified by income, sub-region, and year of publication of data.

With respect to country's income level 29% (95% CI: 24%-34%) of adolescents in low-income countries, 27% (95% CI: 23%-32%) of adolescents in lower-middle income countries and 36% (95% CI: 29%-43%) of adolescents in upper-middle income countries engaged in sedentary behaviour. There was no significant difference in relation to country's income level (Q = 4.37; p = 0.11).

In terms of sub-regional estimates, 38%, (95% CI: 32%-45%) of adolescents in Southern Africa, 34% (95% CI: 29%-40%) of adolescents in East Africa, 26% (95% CI: 23%-29%) of

adolescents in North Africa, and 23% (95% CI: 21%-26%) of adolescents in West Africa engaged in sedentary behaviour. Test of between group difference revealed adolescents in Southern Africa and East Africa engaged in significantly higher sedentary behaviour compared to adolescents in West Africa and North Africa ($Q = 25.15$; $p < 0.001$).

Analysis of sedentary behaviour with respect to year of survey revealed the prevalence of adolescents' sedentary behaviour was 32% (95% CI: 28%-36%) for surveys conducted between 2003 – 2010 and 29% (95% CI: 24%-34%) for surveys conducted between 2010 – 2017. There was no significant difference in sedentary behaviour with respect to survey year ($Q = 1.03$; $p = 0.31$).

Discussion

This study evaluated the prevalence, age, gender, country's economic growth and sub-regional disparities of sedentary behaviour among adolescents (12-17 years) from the twenty-three African countries who participated in the GSHS. Consistent with previous surveys of sedentary behaviour among adolescents in Africa[30,32] we found that considerable proportion of in-school adolescents in the African countries who participated in the GSHS engaged in leisure time sedentary behaviour.

The current finding is higher than that reported in the study by Vancampfort et al.,[30] (26%) but lower than that of the study by Arundell et al.,[8] (57%). It is worth noting that the study by Vancampfort et al.,[30] used a higher cut-off point (≥3 hours) than the recommended >2 hours used in this current study, included adolescents from low-and middle-income countries across the globe, and did not provide regional estimates. Also, the systematic review by Arundell et al.,[8] included studies of adolescents from North America, Europe, Australia, and Taiwan, with no data from Africa. A possible explanation for the relatively lower prevalence of sedentary behaviour found in our study may be the highly physical nature of activity opportunities and

relatively limited electronic devices in the context of screen time for adolescents in Africa.[1,21] Although Africa has witnessed rapid digitization of education materials, this has largely been confined to some parts of the urban settings and relatively low, with the cost of an entry-level internet-enabled device more than 20% of average monthly income in many African countries.[21] Conversely, in some parts of Africa, especially in the rural settings, education activities still take place outdoors, focusing on nature based and experiential learning, characterized by physical engagement and active transportation.[1] Thus, the overdependence on screen-based sedentary behaviour, which have been evident a major contributor to sedentary behaviour, and account for about a third of total sedentary behaviour in other parts of the world,[44] is somewhat reduced in the African setting.

Regarding gender, we found comparable prevalence of sedentary behaviour among males and females, and no gender disparity in sedentary behaviour. This finding corroborates those reported in similar studies.[29,32] Guthold et al.,[29] in their study of sedentary behaviour in schoolchildren from countries across the globe, found comparable prevalence for males and females in African countries. Similarly, Micklesfield et al.,[32] in their study examining sedentary behaviour patterns, and associations with individual, maternal, household, and community factors among rural South African adolescents, found no gender difference in sedentary behaviour. Our finding, however, contradicts that of the study by Muthuri et al.,[23] that found females engaged in higher sedentary behaviour than males in sub-Saharan Africa. A possible explanation for the lack of gender disparity in the present study may be the comparability in adolescent females' household activities and males' recreational activities in the context of sedentary behaviour within the African sub-region. Previous studies from elsewhere in the world have attributed gender disparity in sedentary behaviour to the higher opportunity for adolescent males to engage in recreational activities compared to females.[8,38] In Africa, household activities typically performed by adolescent females such as sitting to prepare meals

285 or hand wash clothes and dishes provide similar opportunity to that of recreational activities
286 males engage in.

287 Additionally, we found that the prevalence of sedentary behavior among middle adolescents
288 was comparable to that in early adolescents. This finding corroborates those reported in similar
289 studies investigating sedentary behaviour in adolescence in sub-Saharan Africa[22,31], but
290 contradicts the findings of other similar studies in sub-Saharan Africa, low-and middle-income
291 countries, and the UK.[30,32,45] A possible explanation for the current finding may be the
292 similarity in lifestyle in these age groups including seated hobbies like reading and talking with
293 friends, increased educational activities because of transition into secondary school and limited
294 active traveling due to being in a boarding school.[1,46] This highlights the need to embed the
295 foundation for lifelong reduced leisure time sedentary behaviour at the early stages of life in
296 this part of the world.[1] Consequently, scaling up regional policy efforts to reduce sedentary
297 behaviour is critical to reducing the prevalence and burden of non-communicable diseases in
298 the sub region.

299 Contrary to our hypothesis, we found no significant difference in the prevalence of sedentary
300 behaviour in relation to country's economic growth. The result of a recent systematic review
301 on impact of economic growth on sedentary behaviour were inconclusive.[24] Ma et al.,[27]
302 assessed sedentary behaviour among young adolescents in low- and middle-income countries,
303 and their relationships with national economic development, and found an inverse association
304 between a country's economic growth and adolescent sedentary behaviour. Similarly, Van
305 Cauwenberg et al.,[28] investigated differential influences of economic growth on European
306 adolescents' sedentary behaviour and found an inverse relationship between a country's
307 economic growth and adolescent sedentary behaviour. By contrast, Chen et al.,[25] assessed the
308 prevalence rates of common health behaviour among adolescents in the five Chinese cities and
309 found a positive relationship between sedentary behaviour and economic growth.

Given the accelerated urbanisation processes, globalisation, and changes in lifestyles in Africa over the last two decades, promoting adolescents' sedentary behaviour[1] we examined if year of survey influenced sedentary behaviour. We hypothesized that access to electronic devices would increase with chronological years and thus lead to increased screen-based sedentary behaviour. We found no significant difference in sedentary behaviour between surveys conducted between 2003 – 2010 and those conducted between 2010 – 2017. A possible explanation may be that although Africa has witnessed accelerated urbanisation processes, globalisation, and changes in lifestyles which promotes sedentary behaviour, one out of five persons in Africa uses the internet as compared with four out of five in developed countries, and as with mobile data, device costs as a proportion of income are highest in Africa.[21] Additionally, although electronic devices access in Africa may have increased in recent decades which promotes screen-based activities, screen-based activities only account for a third of total sedentary behaviour, with the rest of sedentary behaviour being spent in other sedentary behaviours.[7] The African setting largely provide physical opportunities such as active transportation and standing at parks to watch sporting activities.

With regards to sub-region, we found the highest prevalence of sedentary behaviour among adolescents in Southern Africa and East Africa regions. Although the underlying reasons for these findings can only be speculated, the degree of urbanization, educational systems, opportunity for physical activity or cultural differences in these regions may account for the current finding, but evidently, research is needed to understand why there are regional differences in adolescents' sedentary behaviour in Africa. Taken together with the previous finding of similar sedentary behaviour among middle-aged adolescents and early adolescents, it likely that the factors that influence sedentary behaviour are complex and varied, and they may differ across different locations and populations. This highlights the need for context-

specific exploratory studies to better understand factors influencing sedentary behaviour to help inform policy design.

This study possesses a number of strengths. The use of a large representative sample of in-school adolescents, allows for the generalization of the findings to in-school adolescents in the GSHS participating African countries. Additionally, the adoption of random effect model to pool data across the countries is a strength of this study. The study also has some limitations. The GSHS participating African countries included in this analysis exhibited considerable heterogeneity. Readers should therefore be cautious when interpreting the pooled estimates. Emphasis should instead be placed on the distribution in each category and the observed patterns in the data.[47] Additionally, the inclusion of only in-school adolescents and GSHS participating countries, likely underestimate the extent of sedentary behaviour in the sub-region, as for example only 18% of participants in Ghana and Sudan being female, and Nigeria, the most populous country in the region was not included. Furthermore, the lack of confounding factors adjustments limits the drawing of firm conclusions.

Conclusion

The present study explored the prevalence of sedentary behaviour among adolescents from the twenty-three GSHS participating countries in Africa and found a significant prevalence of sedentary behaviour. Notably, the prevalence was highest among adolescents within the Southern Africa and East Africa sub-regions. The prevalence was similar for early and middle adolescents, males and females and for surveys conducted between 2003 – 2010 and 2011 – 2017. Also, country's economic growth did not influence sedentary behaviour. This provides an initial understanding of the prevalence of sedentary behaviour among adolescents in Africa. The considerable prevalence of sedentary behaviour among adolescent in Africa found in study was comparable to those from previous studies and highlight the need for the development of

context specific policies and interventions to help reduce sedentary behaviour and associated burden of non-communicable diseases. Future studies should explore ways to help adolescents reduce time spent in sedentary behaviour to minimize subsequent adverse health outcomes.

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