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Original Research

Prevalence and disparities in adolescents' sedentary behavior from twenty-three African countries: evidence from World Health Organization Global School-based Student Health Survey

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ABSTRACT

Objectives: Studies on sedentary behavior 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 behavior 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 behavior was assessed with a self-reported questionnaire. A meta-analysis using random effect modeling was used to estimate the prevalence, age, gender, country's income level, and sub-regional disparities of sedentary behavior.
Results: Sixty three thousand six hundred thirty five adolescents (12–17 years) were included in the analysis. The prevalence of sedentary behavior was 30% (95% CI: 27%–34%) and significantly higher 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 ($Q = 1.03$; $P = 0.31$). The results were heterogeneous between countries.
Conclusions: The results suggest that a significant proportion of adolescents in Africa engage in sedentary behavior, with the 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 behavior among adolescents in Africa.
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Implications and contribution

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

Introduction

Globally, lifestyles are changing due to economic, educational, cultural, and technological developments, resulting in increased sedentary behavior.[1] Sedentary behavior 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 behavior.[3] Sedentary behavior 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 affect their health and is the most sedentary of pediatric populations, with 57% of their after-school period spent being sedentary.[5–8]

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Conversely, a dose–response relation between increased sedentary behavior and health risk in adolescents has been reported. The evidence indicates that leisure time sedentary behavior 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 behavior guidelines recommend that adolescents should restrict their leisure time sedentary behavior to less than 2 h per day and minimize prolonged sitting.[14–16] An estimated 18–51% of adolescents in Africa engage in leisure time sedentary behavior and sedentary behavior is associated with negative health risks such as overweight, obesity, and depressive symptoms.[17–20]

Accelerated urbanization processes, globalization, and changes in lifestyles have led to a physical activity transition and resulting sedentary behavior of the African population, whose cultural, socio-economic activities, and unique characteristics were previously endowed by a very active lifestyle compared to the rest of the world.[1,21] In the past, education activities took place outdoors especially in African rural settings characterized by physical engagement, and adolescents spent long hours outdoors in active physical activities. Regrettably, this is now characterized by sedentary behavior partly due to the influx of accessible labor-saving devices and facilities, especially in African urban settings, that have flooded the lives of adolescents, with affluence linked to sedentary behavior among adolescents in Africa.[1,20,22,23]

Conversely, studies exploring the impact of economic development and sedentary behaviors among adolescents have been inconclusive.[24] While some studies show a positive association between sedentary behavior and a country's economic growth[25,26] others found a negative or no association.[27,28] Literature indicates there are increasing levels of sedentary behavior 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 engages in leisure time sedentary behavior, in the developing world.[30]

The increasing levels of sedentary behavior coupled with the growing burden of non-communicable diseases in Africa and the known association between sedentary behavior and non-communicable diseases presents a public health challenge in Africa. Unfortunately, there is limited research regarding sedentary behavior during adolescence in Africa,[31,32] making it challenging to estimate the burden of sedentary behavior in the region and develop context-specific recommendations. The very few available studies on sedentary behavior 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 behavior 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 behavior continues and, in some instances, increases in adulthood.[34–36] The aim of this study was thus to examine the prevalence of leisure-time sedentary behavior, 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-regional differences in sedentary behavior, 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 behavior and risk factors among school children and young people. The survey was developed through the 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-administered questionnaires was performed during one regular class period. The sedentary behavior 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 and children), their parents, and/or the school officials. Participants confidentiality was ensured through the anonymity of the data. The 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 behavior were 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 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 behavior

Sedentary behavior 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 h per day and more than 8 h per day. In accordance with previous studies, sedentary behavior was defined as a daily sitting time of greater than 2 h[7,15,40] and the variable was dichotomized ($\geq$2 h/day or not) in this study.

Table 1
Descriptive characteristics of adolescent (12–17 years) in the Global School Health Survey (2003–2017) from 23 African countries.

Country-income	Country	Sub-region	Survey year	Mean age [years]	Response rate [%]	Sedentary Behavior ≥2 h/day *n* (%)	Sample size	Missing values	Female [%]
Low	Benin	West Africa	2016	14.2 ± 0.9	78	393 (24.9)	1576	9	24.9
	Kenya	East Africa	2003	13.9 ± 1.0	89.4	1223 (37.1)	3302	322	36.6
	Liberia	West Africa	2017	14.3 ± 0.9	71	469 (21.1)	2331	277	21.7
	Mozambique	East Africa	2015	14.1 ± 0.8	80	616 (35.0)	1759	46	34.8
	Senegal	West Africa	2005	13.9 ± 1.0	60	743 (25.6)	2898	61	21.6
	Sierra Leone	West Africa	2017	14.4 ± 0.8	82	701 (26.2)	2673	46	26.7
	Tanzania	East Africa	2014	13.6 ± 1.0	87	684 (19.9)	3432	101	19.9
	Uganda	East Africa	2003	14.3 ± 0.8	69	801 (26.6)	3011	111	26.1
	Zambia	Southern Africa	2004	13.9 ± 1.0	70	555 (30.8)	1801	306	32.1
	Zimbabwe	Southern Africa	2003	14.5 ± 0.8	84	866 (45.2)	1918	56	45.5
Lower middle	Djibouti	East Africa	2007	14.3 ± 0.8	83	567 (33.1)	1714	32	31.5
	Egypt	North Africa	2012	13.5 ± 0.9	85	671 (27.4)	2449	37	19.8
	Ghana	West Africa	2012	13.8 ± 1.0	71	708 (20.1)	3526	70	18.7
	Mauritania	East Africa	2010	14.2 ± 0.9	70	707 (36.8)	1921	86	36.9
	Morocco	North Africa	2016	13.7 ± 1.0	91	1827 (29.4)	6223	277	28.4
	Sudan	North Africa	2012	14.2 ± 0.8	77	414 (19.7)	2098	86	18
	Tunisia	North Africa	2008	13.6 ± 1.0	83	680 (24.7)	2756	54	27.6
Upper middle	Algeria	North Africa	2011	13.6 ± 1.1	98	1161 (26.6)	4361	47	24.9
	Botswana	Southern Africa	2005	14.3 ± 0.8	95	735 (34.2)	2148	46	32.8
	Libya	North Africa	2007	13.6 ± 1.0	98	600 (29.1)	2059	82	28.8
	Mauritius	East Africa	2017	13.8 ± 1.0	84	1180 (40.2)	2937	59	42.8
	Namibia	Southern Africa	2013	14.1 ± 0.9	89	1573 (35.9)	4380	66	35.6
	Seychelles	East Africa	2015	13.6 ± 1.1	82	1207 (51.1)	2362	135	54

Sociodemographic 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 Nations classifications.[41] Countries' economic status were categorized 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 sociodemographic and economic data were described and characterized using descriptive statistics such as frequencies, tables, and percentages. Meta-analysis using random-effect modeling was used to estimate the prevalence of sedentary behavior (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 negligible and 40–60% as moderate heterogeneity.[43] The missing data in the survey was not analyzed. The prevalence of sedentary behavior, as well as age, gender, countries' income level, and sub-regional 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

Sixty three thousand six hundred thirty five 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. The majority were females (50%) and middle-aged adolescents, 15–17years (53%). The percentage of female participation peaked in the 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 African, six North African and nine East African countries.

Prevalence and distribution of sedentary behavior

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

The age disparity in sedentary behavior is shown Fig. 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 behavior.

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

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

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

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

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

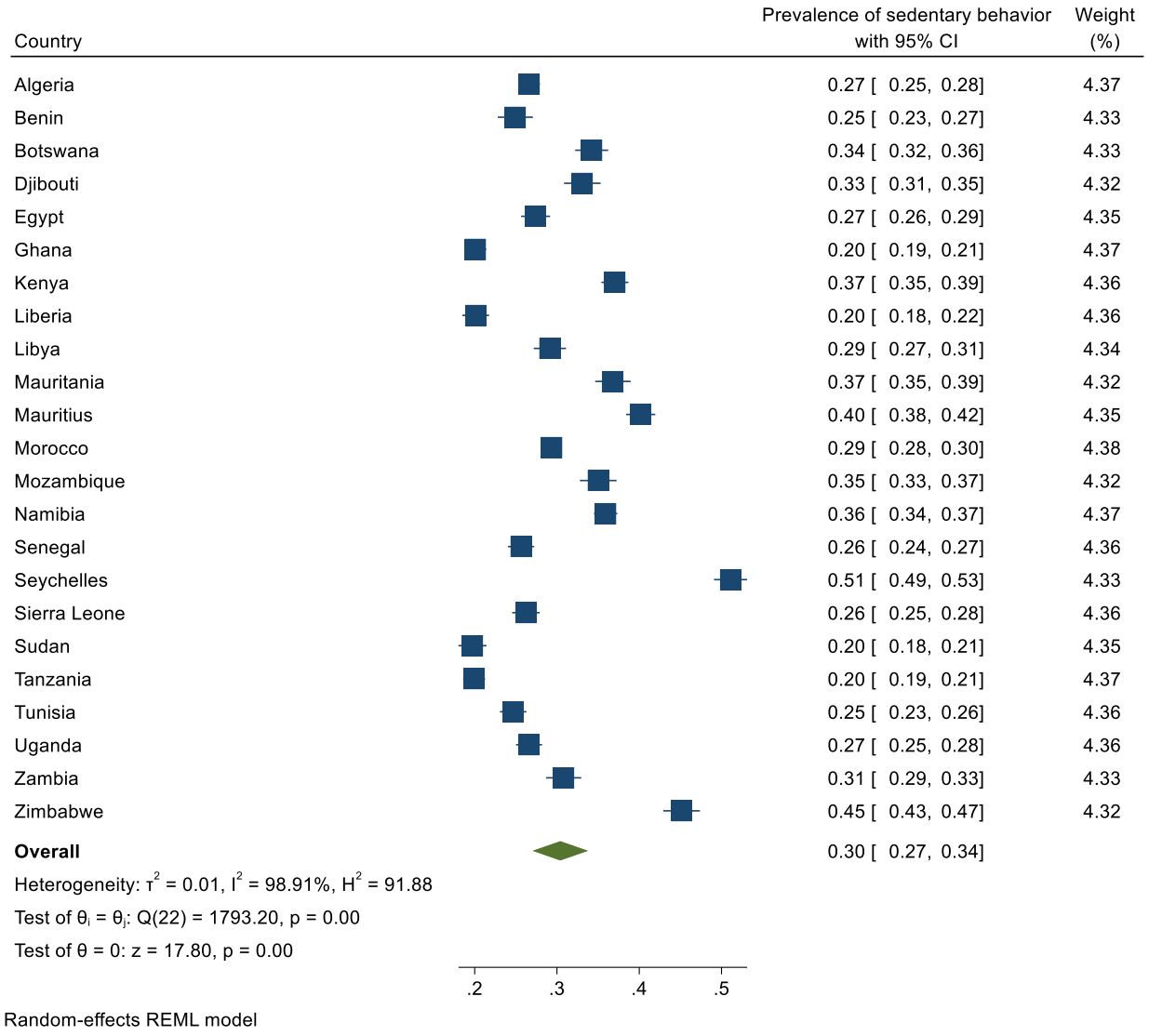


Fig. 1. Prevalence of sedentary behavior among adolescents in Africa.

With respect to the 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 behavior. There was no significant difference in relation to the 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 behavior. A test between different groups revealed adolescents in Southern Africa and East Africa engaged in significantly higher sedentary behavior compared to adolescents in West Africa and North Africa ($Q = 25.15$; $P < 0.001$).

Analysis of sedentary behavior with respect to year of survey revealed the prevalence of adolescents' sedentary behavior was 32% (95% CI: 28%–36%) for surveys conducted between 2003 and 2010, and 29% (95% CI: 24%–34%) for surveys conducted between 2010 and 2017. There was no significant difference in sedentary behavior with respect to the 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 behavior among adolescents (12–17 years) from the twenty-three African countries who participated in the GSHS. Consistent with previous surveys of sedentary behavior among adolescents in Africa[30,32] we found that a considerable proportion of in-school adolescents in the African countries who participated in the GSHS engaged in leisure time sedentary behavior.

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 h) than the recommended >2 h 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 behavior

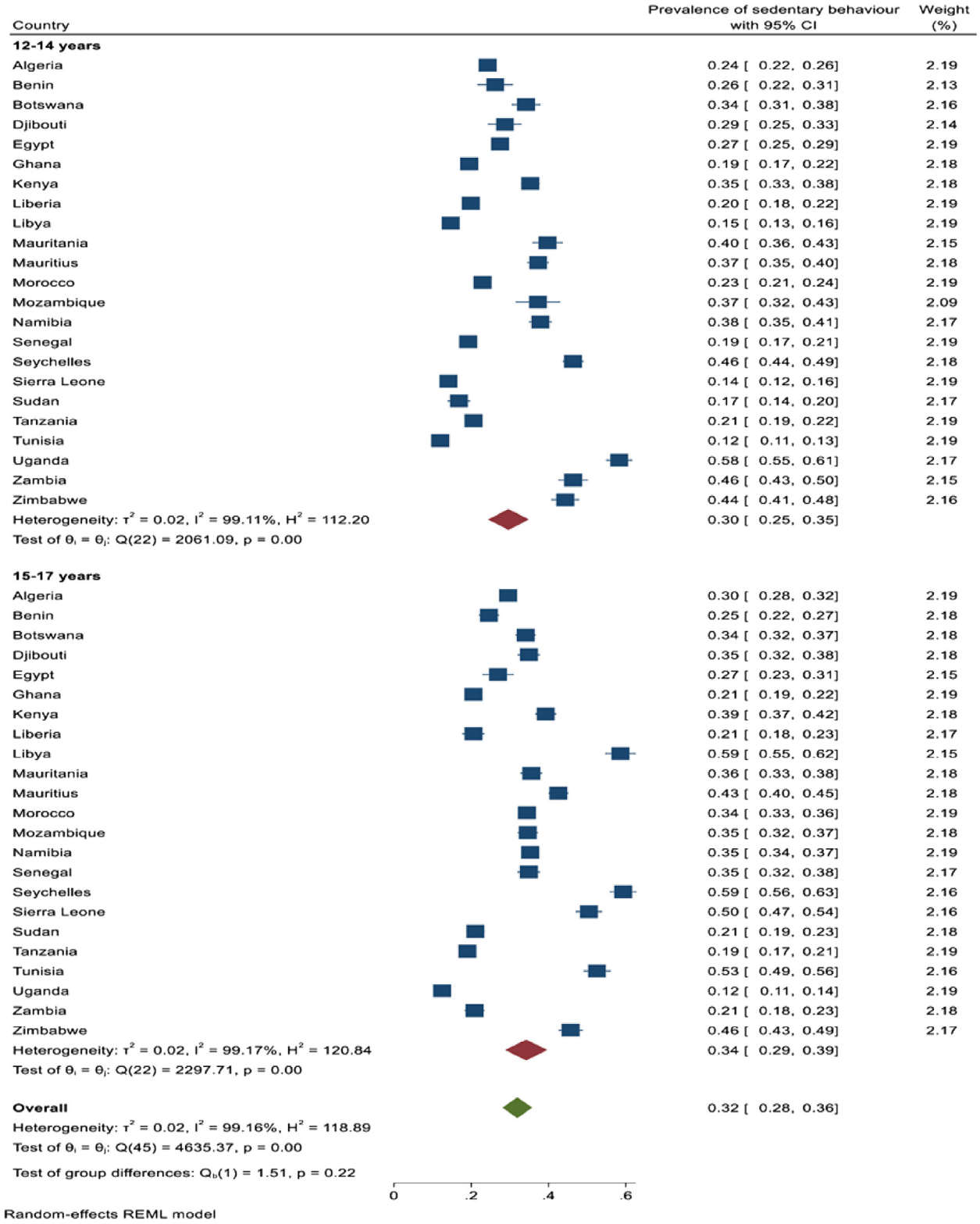


Fig. 2. Prevalence of sedentary behavior among adolescents stratified by age.

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 urban settings and is relatively low, with the cost of an entry-level internet-enabled device is more than 20% of average monthly income in many African countries.[21] Conversely, in some parts of Africa, especially in 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 behavior, which has been evidently a major contributor

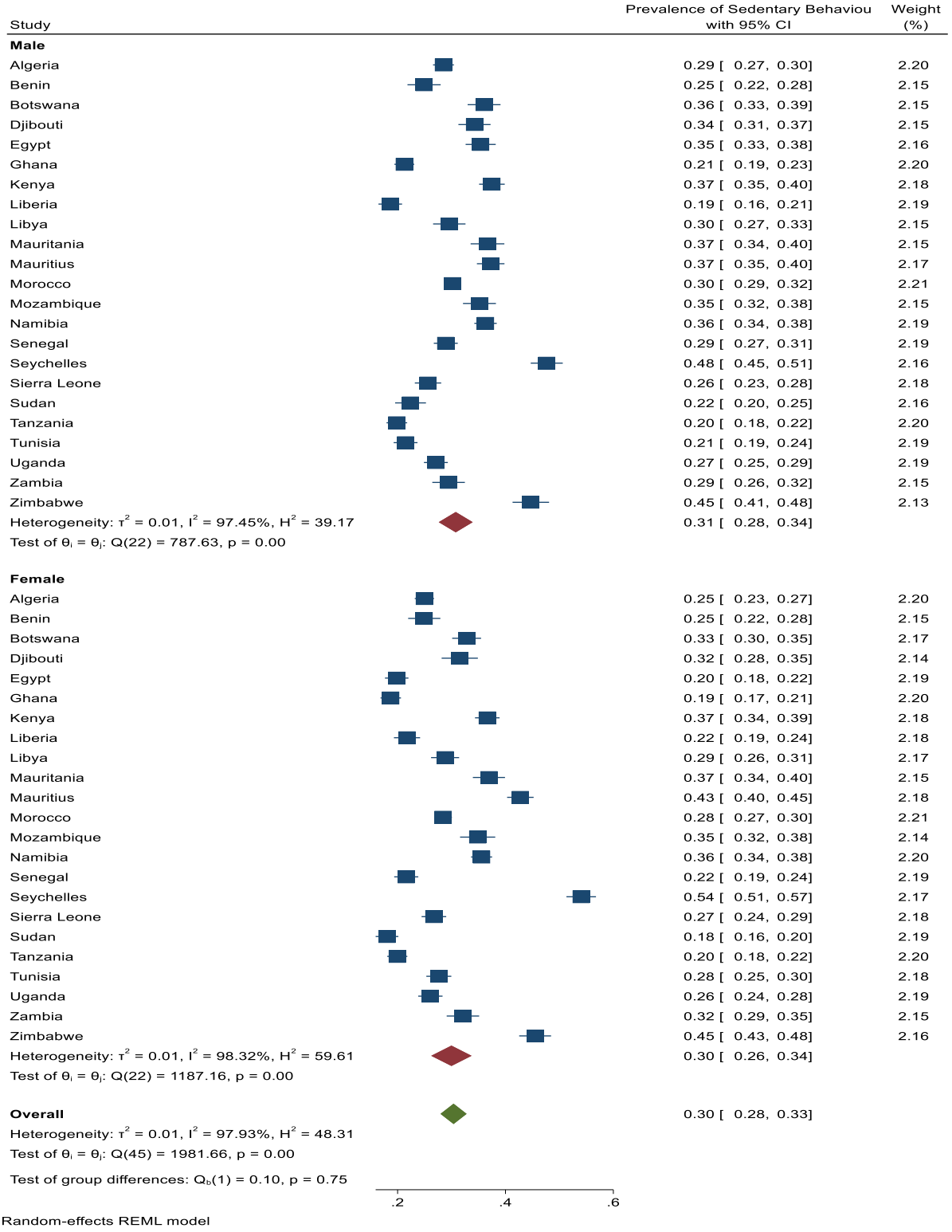


Fig. 3. Prevalence of sedentary behavior among adolescent stratified by sex.

to sedentary behavior and account for about a third of total sedentary behavior in other parts of the world[44] is somewhat reduced in the African setting.

Regarding gender, we found a comparable prevalence of sedentary behavior among males and females and no gender disparity in sedentary behavior. This finding corroborates those reported in similar studies.[29,32] Guthold et al.[29] in their study of sedentary behavior in school children 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 behavior patterns and associations with individual, maternal, household, and community factors among rural

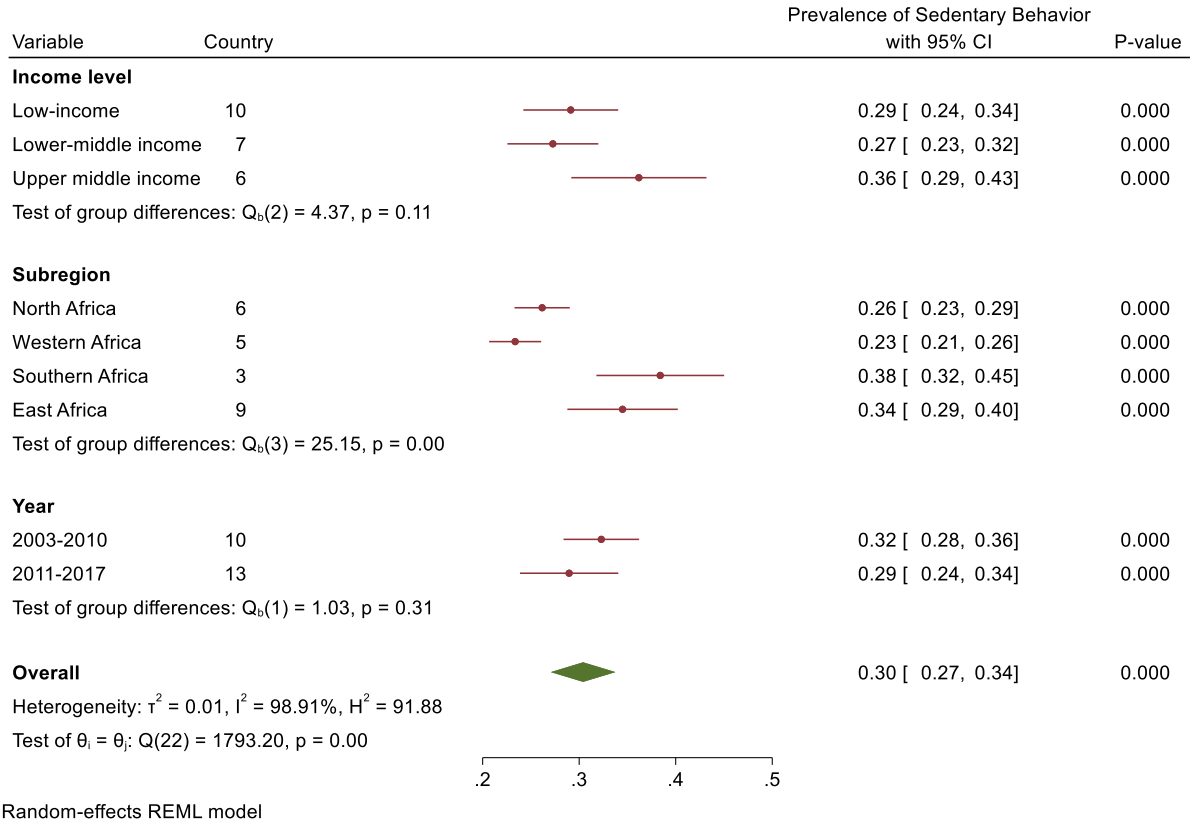


Fig. 4. Prevalence of sedentary behavior among adolescents stratified by income, sub-region, and year of publication of data.

South African adolescents found no gender difference in sedentary behavior. Our finding, however, contradicts that of the study by Muthuri et al.[23] that found females engaged in higher sedentary behavior than males in Sub-Saharan Africa. A possible explanation for the lack of gender disparity in the present study may be the comparability between adolescent females' household activities and males' recreational activities in the context of sedentary behavior within the African sub-region. Previous studies from elsewhere in the world have attributed gender disparity in sedentary behavior 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 or hand washing clothes and dishes, provide similar opportunity to that of recreational activities males engage in.

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

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

Given the accelerated urbanization processes, globalization, and changes in lifestyles in Africa over the last two decades, promoting adolescents' sedentary behavior[1] we examined if year of survey influenced sedentary behavior. We hypothesized that access to electronic devices would increase with chronological years and thus lead to increased screen-based sedentary behavior. We found no significant difference in sedentary behavior between surveys conducted between 2003 and 2010 and those conducted between 2010 and 2017. A possible explanation may be that although Africa has witnessed accelerated urbanization processes, globalization, and changes in lifestyles, which promotes sedentary behavior, one out of five people 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 device 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 behavior, with the rest of sedentary behavior being spent in other sedentary behaviors.[7] The African setting largely provides 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 behavior 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, and 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 behavior in Africa. Taken together with the previous finding of similar sedentary behavior among middle-aged adolescents and early adolescents, it is likely that the factors that influence sedentary behavior 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 behavior 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 effects 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 behavior 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 limit the drawing of firm conclusions.

Conclusion

The present study explored the prevalence of sedentary behavior among adolescents from the twenty-three GSHS participating countries in Africa and found a significant prevalence of sedentary behavior. 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, the country's economic growth did not influence sedentary behavior. This provides an initial understanding of the prevalence of sedentary behavior among adolescents in Africa. The considerable prevalence of sedentary behavior among adolescents in Africa was found in study was comparable to those from previous studies and highlighted the need for the development of context specific policies and interventions to help reduce sedentary behavior and the associated burden of non-communicable diseases. Future studies should explore ways to help adolescents reduce time spent in sedentary behavior to minimize subsequent adverse health outcomes.

Author statements

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Ethical approval

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Competing interests

None.

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