Prevalence of hypertension and selected cardiovascular risk factors among adolescents in selected rural and urban secondary schools in Botswana

Matshidiso Mokgwathi, Julius Chacha Mwita

Abstract

Background: Adolescent hypertension and other cardiovascular risk factors tend to track into adulthood. Consequently, there is a need to determine the prevalence of hypertension and pre-hypertension, and its co-existence with glycaemia, obesity, tobacco and alcohol use among senior secondary school students in Botswana.

Methods: A cross-sectional study was undertaken between December 2015 and March 2016 among students in selected rural and urban senior secondary schools in Botswana. Data were collected through a self-administered questionnaire, measurements and fasting blood glucose testing. Participants were asked about cigarette smoking, alcohol use and levels of physical activity. Body weight, height, waist circumference, blood pressure and fasting blood glucose levels were measured. Hypertension, pre-hypertension, overweight and obesity were defined based on gender, age and height from normative tables.

Results: A total of 252 students with a mean age (standard deviation) of 17.1 (0.9) years participated in the study. Rural students were older than urban students (17.5 vs 16.7 years; \( p < 0.001 \)). The prevalence of hypertension and pre-hypertension were 13.1 and 15.5%, respectively. Physical inactivity (37.7%), overweight/obesity (10.3%) and alcohol intake (9.1%) were also prevalent. Cigarette smoking was rare (2.0%). Impaired fasting glucose levels were found in 1.6% of participants, and none had diabetes mellitus. Hypertension (\( p < 0.001 \)) and cigarette smoking (\( p = 0.019 \)) were more prevalent among male than female participants. Female students were more likely to be overweight or obese than male students (\( p < 0.001 \)). There were no urban–rural differences in hypertension, pre-hypertension and smoking. Urban students were more likely to drink alcohol than rural students (\( p = 0.008 \)).

Conclusion: Hypertension, overweight/obesity and alcohol intake were common among these adolescents in Botswana. Strategies to reduce the risk factors of cardiovascular diseases should be urgently developed and implemented to prevent cardiovascular disease-related morbidity and mortality in the future.

Keywords: hypertension, cardiovascular risk factors, adolescents, Botswana

Demographic and epidemiological changes in sub-Saharan Africa (SSA) have resulted in an increase in non-communicable diseases, including hypertension, leading to concerns and activities to reduce rising rates. In children and adolescents, hypertension is often underdiagnosed and may progress into adulthood. The prevalence of hypertension among children in developed countries is 1–5%. By contrast, the prevalence of hypertension in SSA paediatric populations is 0–12.5 and 0–21.5% for boys and girls, respectively.

Hypertension is usually found in constellation with obesity, smoking, alcohol intake and physical inactivity. All these may track from childhood to adulthood and are predictive of cardiovascular risk later in adult life. The prevalence of all the above risk factors has been increasing among children, mainly as a consequence of urbanisation and changes in lifestyle.

Urbanisation has led to an increase in the use of tobacco and alcohol, poor diet and physical inactivity. For a country with a high burden of HIV/AIDS, the increase in non-communicable diseases, including cardiovascular disease (CVD) and diabetes, poses a challenge for health policymakers and providers to the already stretched health system and progress towards the development of millennium goals.

This is particularly important in Botswana with its high rate of HIV/AIDS, alongside the wish to maintain universal healthcare. There is evidence that early identification and modification of risk factors during childhood decreases the occurrence and magnitude of associated complications due to CVD. However, data on the burden of hypertension and other cardiovascular risk factors among adolescents in Botswana are currently scarce. Consequently, the objective of this study was to determine the prevalence of hypertension and co-existing selected cardiovascular risk factors among secondary school students in Botswana and to use the findings, if pertinent, to guide future strategies in Botswana.
Methods
This cross-sectional study was conducted from December 2015 to March 2016 among students in the rural Shakawe senior secondary school and the urban St Joseph’s College in Botswana. Shakawe is the only senior secondary school in the Okavango, a sub-district with a population of 2,529 inhabitants, mostly subsistence farmers and pastoralists.21 St Joseph’s College is located in Gaborone, the capital city, with a population of 231,592.22

The two schools were conveniently selected based on their ease of accessibility and to provide widely different populations. There were 36 and 42 classes at St Joseph’s College and Shakawe senior secondary school, respectively. Four classes were selected from each school using a simple random-sampling technique.

All students in the selected classes were invited to participate in the study and were provided with a written description of the study, and informed consent forms to take to their parents/guardians (written in both English and Setswana). If willing to allow their child to participate, parents/guardians were then asked to sign the consent form. Students agreeing to participate signed assent forms.

Ethical approval for this study was obtained from the Ministry of Health institutional review board [HPDME: 13/18/1 Vol. X (152)]. Permits were obtained from the Ministry of Education and Skills Development, local authorities in Okavango and Gaborone and from each school administration.

Information on date of birth, gender, alcohol intake and tobacco use, and the level of physical activity was obtained using self-administered questionnaires. Personal and family history of heart disease, hypertension, kidney disease, diabetes mellitus, dyslipidaemia and stroke were also documented. Height was measured in all participants without footwear to the nearest 0.1 cm using a stadiometer. Weight was measured using a digital scale to the nearest 0.1 kg in light clothing and without footwear.

We used WHO AnthroPlus version 1.0.4 software to calculate body mass index (BMI) for all participants aged below 18 years.22 BMI z-scores according to age, gender and height were recorded for each participant and designated as underweight (z-score < –2 standard deviations (SD)); normal weight (z-score –2 SD – +1 SD); overweight (z-score +1 SD – +2 SD); and obese (z-score > +2 SD). For participants ≥ 18 years, adult BMI reference values were used for underweight (≤ 18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25–30 kg/m²) and obesity (≥ 30 kg/m²).23

Waist circumference (WC) was measured to the nearest centimetre in light clothing at the level of the umbilicus using a non-distensible measuring tape. Using the Canadian percentile charts for WC based on gender and age, WC > 90th percentile was categorised as overweight for students < 18 years.24 For students ≥ 18 years, adult cut-offs of 94 cm and 80 cm were used for males for females, respectively.25

After five minutes of rest, two seated blood pressure (BP) measurements were taken from the participants’ right arms using portable sphygmomanometers (BPCB0A–2H, China). The second measurement was taken after a five-minute interval and the average of the two BP readings was recorded. An average systolic blood pressure (SBP) or diastolic blood pressure (DBP) ≥ 95th percentile for age, gender and height was used to define hypertension. Pre-hypertension was defined as SBP and/or DBP ≥ 90th percentile but < 95th percentile.

A repeat blood pressure measurement was done after one week for participants whose readings were consistent with pre-hypertension and hypertension during the initial measurement. Participants whose average SBP and/or DBP remained high in the second visit were categorised as hypertensive and pre-hypertensive as appropriate.25,26 We also defined hypertension among participants who self-reported current antihypertensive medication use.

Fasting blood glucose (FBG) level was measured in mmol/l on capillary blood from a finger-prick test using the Accu-check Performa system (Roche Diagnostics, Mannheim, Germany) following a minimum fasting period of eight hours in participants not known to have diabetes mellitus. Using the American Diabetes Association diagnostic criteria, participants were classified as having normal fasting glucose levels (< 5.6 mmol/l), impaired fasting glucose (5.6–6.9 mmol/l) or diabetes mellitus (≥ 7.0 mmol/l).27

Alcohol use was defined as any reported alcohol consumption in the previous year, while cigarette smokers were current smokers. We assessed self-reported physical exercise duration and intensity in the previous week (both at school and during leisure time) to three levels of physical activity: inactive, minimally active and health-enhancing physical activity.28

Statistical analysis
The prevalence of hypertension and selected risk factors among adolescents is unknown in Botswana. Consequently, the sample size was calculated from the assumption that the prevalence of hypertension in Botswana was 20%, similar to that found in South Africa.29 We needed 250 participants to determine the true prevalence of hypertension with a margin of error of ± 5%.

Data were entered and analysed using SPSS for Windows, version 23.0 (IBM Corporation). Continuous variables (fasting blood glucose, height, weight, WC, SBP, DBP and age) were summarised by means (± SD). Counts and percentages summarised categorical variables. A Pearson’s chi-squared test was used to compare the prevalence of selected cardiovascular risk factors (hypertension, diabetes mellitus, smoking, obesity/overweight, level of physical activity and alcohol use) between urban and rural students.

For univariate analysis of continuous variables (fasting blood glucose, height, weight, WC, age), the Student’s t-test was used. A p-value less than 0.05 was considered statistically significant. Variables that were variables with p < 0.25 in the univariate analysis were included as independent variables for the multivariable logistic regression.

Results
A total of 252 students (132 from Shakawe senior secondary school and 120 from St Joseph’s College) participated in the study (Table 1). Of these, 172 (68.3%) were females, and the mean (SD) age was 17.1 (0.9) years. Students from the rural school were older than those from the urban school (17.5 vs 16.7 years; p < 0.001). None of the participants had a history of diabetes mellitus, stroke or dyslipidaemia.

Overall, obesity or overweight was observed in 10.3% of students (12.5% in the urban school and 8.3% in the rural school). Female students were more likely to be overweight or obese than male students (Table 2). Underweight was found in 25 (9.9%) students, and was more prevalent in male than in female
students. There were no urban–rural differences in the prevalence of underweight.

None of the study participants had diabetes mellitus. Impaired fasting glucose was found in 1.6% of participants (all females), and there were no urban–rural differences in the prevalence of underweight.

Twenty-three (9.1%) participants reported drinking alcohol. Urban students were more likely to drink alcohol than rural students (14.2 vs 4.5%; \( p = 0.008 \)). Smoking was rare in both schools. However, male students were more likely to report cigarette smoking than female students (0.6 vs 5%; \( p = 0.019 \)).

There were 37.7% inactive students, and inactivity was more common in Shakawe senior secondary school students than those at St Joseph’s College. Physical activity did not vary with gender in the two schools.

The mean (SD) SBP and DBP was 118 (13.2) and 71.8 (9.5) mmHg, respectively, and BP was significantly higher among students in the rural school than those in the urban school (Table 1). Overall, the prevalence of hypertension and pre-hypertension was 13.1 and 15.5%, respectively (Table 2). There were no urban–rural differences in hypertension and pre-hypertension. Hypertension was more prevalent among male (OR = 4.3) than female participants (Table 3).

Discussion

In this study, conducted among adolescents in a rural and urban setting in Botswana, a high burden of hypertension was found in constellation with obesity, tobacco use, alcohol use, obesity and physical inactivity. All these may track from childhood to adulthood and are predictive of increased cardiovascular morbidity and mortality later in adult life. For a country with a high burden of HIV/AIDS, the increase in non-communicable diseases is a challenge to the already stretched health system.

The prevalence of all the above risk factors has been increasing among children, mainly as a consequence of urbanisation and physical inactivity. All these may track from childhood to adulthood and are predictive of increased cardiovascular morbidity and mortality later in adult life. For a country with a high burden of HIV/AIDS, the increase in non-communicable diseases is a challenge to the already stretched health system.
change in lifestyle, with urbanisation leading to an increase in the use of tobacco and alcohol, poor diet and physical inactivity. The prevalence of hypertension found in this study was within the prevalence of 0.2 to 24.8% reported in the recent meta-analysis of hypertension studies among African children and adolescents.

Although our findings are consistent with previous studies, we recognise that comparing the prevalence of paediatric hypertension is a challenge due to differences in the definition of hypertension, the age groups of the studied populations and the blood measurement methodology. Nonetheless, the burden of hypertension among our participants was appreciably higher than the prevalence of 3 to 5% among adolescents in the developed world. We also observed a high prevalence of pre-hypertension in our adolescents.

This is a cause for concern in Botswana where about a third of adults are hypertensive. As childhood hypertension progresses to adulthood, the findings suggest that a significant proportion of our participants are at high risk of becoming hypertensive in adulthood. We did not observe an urban–rural difference in the prevalence of hypertension. However, our participants from the rural school were significantly older than their urban counterparts, making it difficult to compare the two populations.

Both hypertension and pre-hypertension were more common in the male students than the females in our study. Our finding may be explained by the fact that male students were significantly older than their female colleagues. Results from the most recent meta-analysis on hypertension in adolescents in Africa however showed no difference between boys and girls in the prevalence of hypertension.

Similar to other studies, overweight/obesity was associated with up to a four-fold increased risk of hypertension among our participants. A similar link between obesity and CVD has been established among adults. Overweight/obesity and hypertension are some of the components of the metabolic syndrome, an indicator of high risk for CVD as well as type 2 diabetes.

The burden of overweight and obesity among our participants is consistent with reports from other SSA countries where between 2.5 and 10.6% of adolescents are overweight or obese. There is evidence that the increase in overweight/obesity is associated with urbanisation. Although we did not see a rural–urban difference in the prevalence of overweight/obesity, earlier data from urban students in Botswana reported a higher proportion of overweight and obesity. Consistent with other studies, overweight/obesity affected more girls than boys.

Although none of the students was found to have diabetes mellitus, 1.6% of participants had IFG. As for the other components of the metabolic syndrome, IFG is a cardiovascular risk factor. This is in contrast to findings from Cote d’Ivoire where 0.4 and 14.5% of adolescents had diabetes mellitus and IFG, respectively. The reasons for this discrepancy are not clear.

A small proportion of both rural and urban students reported using tobacco. This is lower than earlier data from Botswana, in which 10% of the students were current tobacco smokers, and up to 29% reported having tried smoking. Our findings are also inconsistent with the Global Youth Tobacco Survey (GyTS), which reported a prevalence of 10–33% among 13–15-year-olds. Tobacco use was more common among males than females, consistent with a previous study in Botswana.

The lower prevalence of tobacco use among our participants was possibly due to under-reporting of tobacco use because of its prohibited use within schools in Botswana.

Only about 9% of our students reported using alcohol. The figure is lower than what would be expected in a country where nearly half (48.4%) of adults are said to consume alcohol regularly, and again may be due to under-reporting. Similar to a study in Australia, our urban students were more likely to use alcohol than their rural counterparts. It is possible that urban students have more access to alcohol than those in the rural setting, contributing to these findings.

We observed a lower level of physical activity among rural than urban students. This finding was unexpected, most likely explained by the fact that rural students were in a boarding school therefore had minimal travelling distance to their classes.

There are some limitations. The study had a small sample size and relied on some self-reported variables that were prone to recall bias. We measured blood pressure on only two visits. More than two readings would have been needed to provide the best estimate of blood pressure.

Conclusion

This study has shown that hypertension, overweight/obesity and alcohol intake were common among these senior secondary school students in Botswana. Strategies to prevent the risk factors of CVD should be developed and implemented to avoid CVD-related morbidity and mortality in the future. These strategies are being advanced and will be the subject of future research.

This work was supported by the University of Botswana Office of Research and Development (ORD) Post-graduate Internal Funding (Round 6). The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

References


