The association of physical activity, body mass index and the blood pressure levels among urban poor youth in Accra, Ghana.

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Background

Adolescence high blood pressure (HBP) affects adolescence health and eventually results in other health problems in later life.[1-3] Yet most studies on blood pressure (BP) have focused on the adult population. Specifically, hypertension is under diagnosed in the youth population[4] since few studies have explored its risk factors in this group.[5,6] Meanwhile, childhood and adolescence physical inactivity and obesity as well as certain lifestyle behaviors such as the use of tobacco and alcohol consumption, which are associated with HBP have increased among the young population.[7-10] It has been projected that in the next decade, there will be a worldwide increase (15%) in death rates from cardiovascular diseases (CVDs): Africa will record over 20% increase.[11] This will make CVD the most common cause of death compared to communicable diseases and it is projected to affect the younger age population especially in most low and middle-income countries (LMIC).[12] Most of these deaths will be attributed to HBP.[13,14] Urban poverty is associated with poor living conditions which influence health.[15] In sub-Saharan Africa (SSA), CVD accounts for a considerable proportion of the chronic disease burden[16]. The prevalence of HBP is between 30-40% for both rural and urban communities among the aged.[17] As predicted to increase, this will consequently add to the already high burden of infectious diseases. Comparatively, Ghana also has a high prevalence of 28.7%.[18]

Individual lifestyle behaviors associated with urbanization accounts for the increasing prevalence of HBP in urban areas.[5] Among them are: lack of physical activity (PA), alcohol overconsumption, smoking or substance use, unhealthy diets, obesity and psychosocial stressor.[19] These factors are now evident and also high among the younger population (15-24).[20] However, while it is established in most developed countries that PA in adolescents and youth reduces risk of obesity and HBP in later life,[21] the association is unclear in most developing countries. For Ghana as other SSA countries, major causes of death have moved from predominantly communicable disease to a combination of communicable and chronic non-communicable diseases (NCDs); the protracted polarized epidemiological phase.[16, 22] In Accra, the capital city, urban poor areas are predicted to experience increasing burden of HBP and other NCDs.[15] Also, hypertension has moved from the 4th to the 2nd place as the primary cause of outpatient morbidity in 2007.[23]

In Ghana, the overall prevalence of overweight has increased from 25.5% to 30.5% between 2003 and 2008.[24] Overweight and obesity which previously were attributable to aging lifestyle behaviors are equally now common among adolescents and children due to low levels of PA, poor diets and increasing levels of alcohol intake.[25] Childhood obesity increased from 0.5% in 1988 to 1.9% in 1993 and to 5% in 2008 in Ghana. Among the youths aged 15–19 and 20–24 in Ghana, there has been an increase from 7.2% to 9.0% and 15.1% to 16.6%, respectively in the same period.[24] Childhood and adolescent PA has an effect on adult obesity and BP. [2, 17, 26, 27] PA reduces risk of obesity, which once established in adolescent and youthful age is hard to reverse.[21] Furthermore, physically active adolescents are at a lower risk of developing other conditions such as type II diabetes in future.[28] Hence BMI and PA are notable factors that relates with BP, and so prevention should begin early in life.[29, 30] This study has two main aims: (a) to assess the PA, body mass index (BMI) and BP levels; and (b) to examine the association of PA, BMI and BP by gender of the urban poor youth in Accra, Ghana.

Methods

Study Areas

We conducted a cross-sectional study among residents of three urban poor areas; Ga Mashie (James Town and Ussher Town) and Agbogbloshie between November 25th and December 22nd 2011. James Town and Ussher Town are coastal fishing communities. Both communities are largely indigenous Ga. Residential structures are mostly cement-walled with few places designated for recreational activities. Agbogbloshie on the other hand, is a multi-ethnic migrant community embedded in a major market area. Unlike Ga Mashie, there are mostly closed unplanned residential wooden-walled (kiosk) structures. There are also very few places for recreational activities.

Study design

The study forms part of a cross-sectional survey (2nd-wave of the EDULINK Urban Health and Poverty, 2011). Forty (40) households were systematically selected from the 29 randomly selected enumeration areas (EAs) of the three localities. With a response rate of 70% only 974 individuals were interviewed after informed consent was obtained. Among them, 201 (62.4% of the proportion of youth) aged 15 to 24 years[31] were sampled. Anthropometric measurements (weight, height, waist and hip circumference) were collected from this cohort. Height measurements were obtained using a measuring tape (5M/16FT measuring tape) in centimeters (cm) after removal of slippers or shoes and a weighing scale (Seca Scale with maximum measurement of 150kg) provided individuals' weights in kilograms (kg). The survey further asked respondents about their involvement in an activity in their free time of the past 7 days, whether they had used tobacco in the past 30 days and also if they had taken alcohol in the past 7 days. Similarly, the age, sex, educational attainment, locality of residence and their employment statuses were collected. BP measurements were taken three times using appropriate cuff sizes with a validated electric BP monitor (Microlife® Watch BP®). The measurements were taken within an interval of 2 minutes on either arm of the respondent after ensuring that they were either relaxed or sat appropriately, had not eaten or taken alcohol for the past 30 minutes and not pregnant if female. The average of the three readings was used for the analysis. The study protocol was approved by the Institutional Review Board of the Noguchi Memorial Institute for Medical Research-University of Ghana.

Measurements

Optimal systolic and diastolic BP was categorized respectively (≤ 120mmHg and ≤ 80mmHg). Pre-hypertension was also defined respectively for systolic (> 120mmHg and ≤ 139mmHg) and diastolic BP (> 80mmHg and ≤ 89mmHg). For hypertension, systolic BP was ≥ 140mmHg, and diastolic BP was ≥ 90mmHg.

BMI was calculated by dividing the weight (kg) of the respondent by the height in meters squared (m^2). They were later classified as being overweight (BMI $\geq$25kg/m^2) and obese (BMI $\geq$30kg/m^2) according to the 2004 World Health Organization (WHO) cut-off points. Both BP and BMI were categorized to answer the first aim of the study, and for the second, they were considered as continuous variables. Leisure time PA is considered in this study. This is because it involves an activity which is planned, structured, and repetitively undertaken with the primary function of increasing physical fitness.[32] Therefore respondents were asked in the survey to describe the number of times they were involved in an activity of their free time in the past 7 days preceding the survey. Subjects were categorized to have done no activity when all or most of their free time was spent doing things that involved little physical effort. For moderate activity, subjects who sometimes/often (1-4 times last week) did PA in their free time were termed as such whereas those who quite often/very often (5 or more times last week) did PA in their free time were considered to have done vigorous kinds of activity.

Data analysis

The analysis was done using the IBM Statistical Package of Social Sciences (SPSS) version 19 (SPSS Inc. Chicago, USA). Percentages were used to determine the distribution of the youth by the variable of interest by sex. The association between PA, BMI and BP by sex were examined using bar graphs. Multiple linear regression analyses were also performed separately by sex in order to determine the factors influencing the associations of BMI and PA to systolic and diastolic BP; while adjusting for other related variables such as age, education, employment status, locality, smoking and alcohol consumption. P-value $\leq$0.05 were considered as statistically significant.

Results

Characteristics of the population

Table 1 shows the characteristics of the youth population under study by sex. There were 113 females and 88 males. About two-thirds (60.7%) of the youth were from Ussher Town. Almost half (42.8%) of the youth had completed basic education: there were more males than females who had completed basic education (50.0% vs. 37.2% respectively: p<0.050). A little over a half

(53.7%) of them were employed; a higher proportion of the males were employed compared to the females (65.9% vs. 44.2%; p<0.050). We also present in Table 2, the levels of PA, BMI and BP. The youth were mostly of normal weight (67.2%) and by comparison, females had higher BMI than the males (23.6kg/m^2 and 21.7kg/m^2; p<0.050 respectively). Consequently, female youth had higher proportions of overweight and obesity (17.7% and 13.3% respectively) compared with the male youth. About four-fifths (84.1 %) were physically inactive: the male youth engaged in PA more than the female youth (15.9% and 4.4% respectively: p<0.000). As regard lifestyle, more males had either consumed alcohol or smoked tobacco compared to the females (p<0.050). About a fifth (22.9%, former drinkers; and 28.9%, current drinkers) had either taken alcohol in the past or had been consuming alcohol in the past 30days. More than one-tenth (14.4%) had ever smoked (Table 1).

PA, BMI and BP levels

About one third (32.3%) of the youth had BP in the pre-hypertension category: a proportion of 42% of the male youth had pre-hypertension compared to 24.8% for females (p<0.050). For hypertension, close to 7% and 2% were identified respectively for males and females: in total, only 4% had hypertension. Average systolic and diastolic BP levels consistently increased with higher BMI (Figures 2a & 2b). In contrast, higher levels of PA showed a more decreasing pattern for diastolic BP (Figures 3a and 3b).

Generally, male youth have high systolic and diastolic BP levels compared to females (p>0.050). This follows from Figures 1a and 1b which showed that both systolic and diastolic BP increased with age of youth and this was higher for males compared to the females. Table 3 shows multiple linear regression analysis of factors associated with systolic and diastolic BP stratified by sex. The regressions showed that BMI was positively associated with only systolic BP (p<0.050) for both male and female when confounding factors were accounted for. The influence of BMI on systolic BP was stronger for males compared to the females (β=1.382mmHg vs. β=0.793mmHg). Although PA was not significantly associated with systolic and diastolic BP in this study, moderate PA reduced BP level for both male and female youth, but vigorous PA reduced BP for only males. For systolic BP, there was a decrease of -2.157mmHg and -2.734mmHg respectively for both moderately active male and female youth; however, for vigorous PA female youth had an increase of 9.933mmHg while the male youth a decrease of -3.787mmHg.

Among the confounders, locality was a significant predictor for both systolic and diastolic BP, and this was only significant for females. For systolic BP, females in James Town recorded an increase of 5.120mmHg compared to those of Ussher Town. Similarly, the female youth from James Town had an increased diastolic BP of 3.834mmHg compared to their counterparts from Ussher Town, nonetheless, females from Agbogbloshie had a higher increase (β =5.987mmHg) than those from Ussher Town.

Discussion

Key findings

Our findings suggest a higher prevalence of pre-hypertension among the urban poor. Prevalence was higher in males than in females. Both systolic and diastolic BP increased with increasing levels of BMI; this was prominent among males.

Discussion on the Key findings

Our results add to the knowledge base on the dynamics of risk factors of HBP and mortality in Ghana. The male youth were found to have higher prevalence of pre-hypertension and hypertension than their female peers. This is consistent with studies of some developed countries, where cases of stroke and other CVDs are reported mostly among males due to the risk of HBP compared to females.[33-35] Thus, males usually have higher morbidity and mortality of CVD and lower life expectancy than females.[36] The gender difference is however contrary to studies from other rural and urban communities in Ghana, where girls aged 8-16 years had HBP than boys.[6, 9] Also, hypertension was more common in females than in males aged 40 to 75 years in a study in the Ashanti region of Ghana.[29] Mkhonto et al (2012) also found among a rural population aged 20 to 95 years in South Africa, that hypertension was significantly higher in females than in males.

Primarily, the prevalence of overweight and obesity coupled with low PA[38] among the urban poor youth may explain, at least in part, the HBP in these areas. A look at the influence of these two main variables indicated that an important variable of concern to HBP is BMI, which had a strong positive association.[39] This supports recent evidence in the US where hypertension rates are increasing among overweight and obese young children aged 11 to 13.[40] Therefore focusing on reducing or maintaining a balanced or ideal BMI is important in attaining good health. The influence of overweight and obesity in some urban areas, has led agencies like the WHO "to advocate using community (re)design as a tool to curb obesity" in some developed countries. Some of these advocacies include improvement of geographic availability of supermarkets in underserved areas, access to outdoor recreational areas and enhance infrastructure supporting walking.[41]

This study revealed that females had higher proportions of overweight and obesity than the males, yet there was a high average systolic and diastolic BP for each BMI level for the males, among whom BMI was significantly associated with systolic. Goon et al (2013) reported similar findings. In their study among children aged 7-13 years in rural South Africa, the incidence of elevated BP was high for boys compared to girls, although overweight occurred more in girls. Another study by Mkhonto et al (2012) in South Africa supports the association of BMI and BP; BMI and waist circumference were significant determinants of elevated systolic and diastolic BP for both male and female but only waist to hip ratio (WHR) was significant for males. However, females had elevated BP compared to the males. Several studies admit that the mechanisms by which BMI influences hypertension are poorly understood and hence the sex differences are difficult to explain. It is unclear in this study of the sex differences, although some factors have been thought to be influential. Of particular interest are modifiable determinants including physical inactivity, higher levels of alcohol intake and high levels of substance use; the females were more inactive, while males constituted higher proportions of alcohol intake and substance use. However, these factors were not significantly related with BP in this study.

Further in this study, PA showed no clear association with BP especially systolic BP. Mkhonto et al (2012) also found similar association in their studies. However, Luke et al (2011) advocate the health advantages of PA, and explain that it may solely not be the driving force behind the rise in obesity and other CVDs. In these urban poor communities, the youth were mostly inactive, since there are very few spaces for recreational activities. Hence, advocating for PA can help in maintaining a healthy body weight, thus reducing the risk of HBP[30] and further promote economic productivity since they form the majority part of the working force.[43]

Limitations

The study has some limitations. First of all, the study is cross-sectional. Therefore BP was measured at a single visit and this does not allow for causal association to be established. There is also a potential bias in the self-reported participation of leisure PA. For instance, subjects' recall bias effect may introduce some inconsistencies into the analysis. Also, the small sample size does not give enough power to make certain conclusions and generalizations. Despite these limitations, the findings in this study are consistent with other findings.

Conclusion

Findings from this study indicate that the BMI of the urban poor youth has a strong positive relationship with BP. The fact that youthful hypertension has the tendency of translating into adult hypertension admits that, it is eminent for stakeholders to invest in placing emphasis on HBP by looking at its risk factors such as BMI among urban poor communities.

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Table 1: Characteristics of the study population by sex

		SEX		
	All (n=201)	**Male (n=88)**	**Female (n=113)**	***P-value***
Age N (%)				0.086
15-18	39 (19.4)	23 (2*6.1)*	*16 (14.2)*	
1*8*-20	67 (33.3)	25 (28.4)	42 (37.2)	
21-24	95 (47.3)	40 (45.5)	55 (48.7)	
Mean	*20.04*	*19.7*	*20.4*	
Std. deviation	*2.667*	*2.754*	*2.570*	
Education N (%)				0.002
No education	8 (4.0)	1 (1.1)	7 (6.2)	
Primary	46 (22.9)	11 (12.5)	35 (31.0)	
Middle/JHS	86 (42.8)	44 (50.0)	42 (37.2)	
Secondary +	61 (30.3)	32 (36.4)	29 (25.7)	
Alcohol-use N (%)				0.198
Never drinker	98 (48.8)	21 (23.9)	56 (49.6)	
Former drinker	46 (22.9)	25 (28.4)	21 (18.6)	
Current drinker	57 (28.9)	42 (42.7)	36 (31.9)	
Smoked tobacco N (%)				0.181
Never smoked	172 (85.6)	72 (81.8)	100 (88.5)	
Ever smoked	29 (14.4)	16 (18.2)	13 (11.5)	
Locality N (%)				0.579
Agbogbloshie	36 (17.9)	14 (15.9)	22 (19.5)	
James Town	43 (21.4)	17 (19.3)	26 (23.0)	
Ussher Town	122 (60.7)	57 (64.8)	65 (57.5)	
Employment status N (%)				0.002
Unemployed	93 (46.3)	30 (34.1)	63 (55.8)	
Employed	108 (53.7)	58 (65.9)	50 (44.2)	

Table 2: BMI, PA and BP levels of the study population by sex

		SEX		
	All (n=201)	**Male (n=88)**	**Female (n=113)**	***P-value***
Mean Height (cm)	163.1	167.9	159.4	0.076
Std. deviation	*8.730*	*8.584*	*6.845*	
Mean Weight (kg)	60.5	61.1	60.0	0.080
Std. deviation	*12.576*	*10.876*	*13.823*	
BMI (kg/m^2)	22.8	21.7	23.6	0.002
Std. deviation	*4.863*	*3.963*	*5.327*	
Overweight N (%)	26 (12.9)	6 (6.8)	20 (17.7)	
Obese N (%)	17 (8.5)	2 (2.3)	15 (13.3)	
Systolic BP (mmHg)	115.6	120.2	112.1	0.246
Std. deviation	*12.709*	*13.780*	*10.573*	
Diastolic BP (mmHg)	70.0	70.2	69.1	0.571
Std. deviation	*8.092*	*8.125*	*8.069*	
Pre-hypertension N (%)	65 (32.3)	37 (42.0)	28 (24.8)	0.009
Hypertension N (%)	8 (4)	6 (6.8)	2 (1.8)	0.069
Physical activity N (%)				0.000
No PA	169 (84.1)	62 (70.5)	107 (94.7)	
Moderate PA	19 (9.5)	14 (15.9)	5 (4.4)	
Vigorous PA	13 (6.5)	12 (13.6)	1 (0.9)	

Table 3: Multiple linear regression of factors associated with systolic and diastolic blood pressure by sex

	Systolic blood pressure						Diastolic blood pressure					
Characteristic	**Male**			**Female**			**Male**			**Female**		
	β	**SE**	**P**	**β**	**SE**	**P**	**β**	**SE**	**P**	**β**	**SE**	**P**
BMI	***1.382	0.368	0.000	***0.793	0.195	0.000	0.308	0.230	0.184	0.245	0.154	0.113
No PA (***REF***)	0			0			0			0		
Moderate PA	-2.157	3.396	0.527	-2.734	2.291	0.235	-3.215	2.117	0.133	-1.858	1.808	0.307
Vigorous PA	-3.787	4.939	0.446	9.933	10.036	0.325	-4.702	3.079	0.131	6.920	7.923	0.384
Age	0.108	0.625	0.863	0.342	0.443	0.441	0.606	0.389	0.124	0.409	0.350	0.245
Never smoker (***REF***)	0			0			0			0		
Smoker	-3.308	4.237	0.437	4.173	3.101	0.181	0.607	2.642	0.819	-0.445	2.448	0.856
Never drinker (***REF***)	0			0			0					
Former drinker	-2.315	3.582	0.520	1.665	2.658	0.532	1.591	2.233	0.478	2.621	2.098	0.214
Current drinker	0.487	3.967	0.903	1.366	2.317	0.557	0.490	2.473	0.844	0.875	1.829	0.633
Unemployed (***REF***)	0			0			0			0		
Employed	-3.749	3.516	0.290	-0.558	2.202	0.800	0.399	2.192	0.856	-1.243	1.738	0.476
No education (***REF***)	0			0			0			0		
Primary Educ.	-3.185	14.088	0.822	3.245	4.120	0.433	0.680	8.783	0.938	-1.756	3.252	0.590
Middle/JHS	1.837	13.763	0.894	3.664	4.077	0.371	4.723	8.580	0.584	0.276	3.218	0.932
Secondary +	3.385	13.802	0.807	7.165	4.353	0.103	6.863	8.604	0.428	2.051	3.436	0.552
Ussher Town (***REF***)	0			0			0			0		
Agbogbloshie	-2.079	4.495	0.645	2.749	2.539	0.282	3.457	2.802	0.221	**5.987	2.005	0.004
James Town	1.278	3.793	0.737	**5.120	2.441	0.039	0.893	2.365	0.707	**3.834	1.927	0.049
Adjusted R^2			**0.130**			**0.162**			**0.027**			**0.103**

P<0.0001; **P<0.05; (REF)*****:** Reference category; **β:** beta coefficient; **SE:** Standard Error.