

## Research Article

# Rural-urban comparison in prevalence of hypertension and its factors among adolescents of Sarawak, Malaysia: A cross-sectional study

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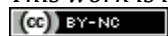
## Abstract

**Objective:** This paper reports a study of the prevalence of pre-hypertension and hypertension, and its associated factors among secondary school students in Sarawak. **Methods:** It was a cross-sectional study using a questionnaire, anthropometric and blood pressure measurement. **Results:** A total of 2461 secondary school children participated. The prevalence of pre-hypertension was 13.2%, stage 1 hypertension was 12.4% and stage 2 hypertension was 4.6%. The prevalence of overweightness and obesity was 24.3%, elevated waist circumference was 13.5, and overfat and obese was 6.7%. Based on the urban model, factors that were associated with pre-hypertension were age, gender, parent with history of hypertension, overweightness and obesity. At the hypertension level, only maleness, overweightness and obesity were found to be associated factors.

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A higher odds ratio was found for elevated waist circumference of 4.42 (95% CI:1.75, 11.11) to be associated with hypertension. In the rural model, factors found to be associated with pre-hypertension were age, male, ethnic group (Chinese), overweight and obese and elevated waist circumference. For the pre- hypertension level, variables that were consistently associated with hypertension were male, ethnic group (Iban and Chinese), overweight and obese, elevated waist circumference, and parent with history of hypertension, overfat and obese. **Conclusions:** The prevalence of pre hypertension and hypertension was found to be different between urban and rural areas, gender and obesity were found to be associated with elevated blood pressure. There is a need to emphasize earlier detection and intervention among younger generation on hypertension.

**Key words:** Hypertension, adolescent, overweight and obesity, elevated blood pressure

## **Malezya, Sarawak ergenleri arasında hipertansiyon prevalansının ve ilişkili faktörlerin kırsal ve kentsel karşılaştırılması: Kesitsel bir çalışma**

### **Öz**

**Amaç:** Bu makale Sarawak'ta ortaöğretim öncesi öğrencilerinde pre-hipertansiyon ve hipertansiyon prevalansı ve ilişkili faktörler üzerine bir çalışmayı rapor etmektedir. **Yöntem:** Kesitsel yapılan bu çalışmada anket kullanılmış ve antropometrik ve kan basıncı ölçümleri yapılmıştır. **Bulgular:** Toplam 2461 ortaokul öğrencisi katıldı. Pre-hipertansiyon prevalansı %13.2, evre 1 hipertansiyon %12.4 ve evre 2 hipertansiyon %4.6'ıydı. Aşırı kilo ve obezite prevalansı %24.3, yüksek bel çevresi 13.5 ve aşırı yağ ve obez %6.7 idi. Kentsel modele dayanarak, pre-hipertansiyon ile ilişkili faktörler yaş, cinsiyet, hipertansiyon öyküsü olan ebeveyn, aşırı kilo ve obezite idi. Hipertansiyon düzeyinde, sadece erkek cinsiyet, aşırı kilo ve obezite ilişkili faktörler olarak bulundu. Yüksek bel çevresi ile hipertansiyon oluşma olasılıklar oranı yüksek bulundu OR=4.42 (%95 CI:1.75,11.11) bulundu. Kırsal modelde pre-hipertansiyon ile ilişkili bulunan faktörler yaş, erkek cinsiyet, etnik grup (Çinli), aşırı kilolu ve obez olma ve yüksek bel çevresidir. Pre-hipertansiyon için, tutarlı olarak hipertansiyon ile ilişkili değişkenler erkek cinsiyet, etnik grup (Iban ve Çin), aşırı kilolu ve obez olma, yüksek bel çevresi ve ailesel hipertansiyon, aşırı yağ ve obezite öyküsüne sahip olmaydı. **Sonuç:** Pre-hipertansiyon ve hipertansiyon prevalansı kentsel ve kırsal alanlar arasında farklı saptanırken, cinsiyet ve obezite yüksek kan basıncı ile ilişkili bulundu. Hipertansiyonda genç nesil arasında erken teşhis ve müdahalenin vurgulanması gerekmektedir.

**Anahtar kelimeler:** Hipertansiyon, ergen, aşırı kilo ve obezite, yüksek tansiyon

## **Introduction**

Overweight and obesity in adolescent is an epidemic health issue worldwide, affecting both developed and developing countries<sup>1</sup>. According to the WHO<sup>2</sup>, an estimation of 43 million children (including 35 million from developing countries) are overweight and obese and this figure will reach 60 million in 2020. The literature has indicated that an increase of obesity among younger age groups affect their health status in adulthood.<sup>3</sup> Comorbidities such as diabetes mellitus, hypertension, and cardiovascular diseases are on the rise due to an increase uncontrolled body weight at younger age attributed to changes in dietary habits, lifestyle behaviors and socio-economic factors.<sup>4</sup>

Hypertension is the one the most common non-communicable disease affecting overweight and obese adolescents. Adolescents who are overweight and have hypertension are more likely to have elevated body weight and blood pressure when they enter adulthood.<sup>3,5</sup> Among the types of hypertension, essential hypertension is recognized as one of the most common condition affecting adolescents, usually asymptomatic unless for those with high risk signs.<sup>6</sup> Thus, detecting hypertension in adolescents can be challenging and not a routine procedure which can be carried out in the healthcare or school setting. Excess body weight and fat are some of the common factors associated with hypertension in adolescents, beside dietary intake high in fat and salt, sedentary lifestyle, physical inactivity, and family history of hypertension.<sup>7</sup>

In Malaysia, the prevalence of hypertension among adults in 2012 was 38%, with the highest from Sarawak (43%).<sup>8</sup> In adolescents, the prevalence of hypertension was reported to be between 11.6% to 33.1%.<sup>8,9</sup> Such trends were found to be consistent with the increase in overweightness and obesity, evidenced in the study carried out among 714,922 young respondents aged 16-19 years which showed that an increase of one unit in BMI was

associated with a higher risk of elevated blood pressure.<sup>10</sup> A longitudinal study among adolescents in US found a higher risk of hypertension among those who were chronically overweight/obese compared with those of normal weight within the same timeframe, supporting the likely association between childhood obesity and hypertension in adulthood.<sup>11</sup>

Sarawak, located in Borneo Island, is the largest state of Malaysia with a total land area of 124,450 square kilometers (48,050 sq mi). It is the least populated state in Malaysia with more than 40 sub-ethnic groups. Due to its cultural and linguistic diversity, it has a distinct and unique culture compared to other parts of Malaysia. Although studies on hypertension in Malaysia have been carried out, not many published information was found in Sarawak, particularly in relation to a comparison between urban and rural settings. Past studies have shown a significant influence of urbanization and its impact on childhood lifestyle, which could lead to higher CVD risk factors, including hypertension among urban and rural children<sup>12</sup>. Nevertheless, it remains unclear if the differences between rural and urban settings could contribute as risk factors of hypertension. Hence, this paper aims to examine the differences between the rural and urban settings in terms of the prevalence of pre-hypertension and hypertension, and its associated factors.

## **Material and method**

This cross-sectional study used a quantitative research methodology. Data was collected using a questionnaire, anthropometric and blood pressure measurements.

A list of all government secondary schools in Sarawak was compiled from the latest Ministry of Education database (February 2014). Schools were classified first by location (urban, rural) and then by district (Sarawak: Miri, Kuching, Bintulu etc.) The grouping of schools was then placed into a

comprehensive ordered list for sampling. The probability of a school being selected was calculated based on the size of its enrollment in relation to the total enrollment for the state and the number of schools needed for the study. Schools with large enrolment were more likely to be selected because their students represented a larger proportion of the student population. Sample size was calculated using sample size for finite population<sup>13</sup>, based on a confidence level of 99% with approximately 2.8% degree of accuracy, total sampling frame of 200300, estimated sample size of 2520 was needed, with 20% attrition rate. Systematic sampling methodology was carried out based on the numbers of schools needed (n=18). The total enrolment of secondary school students in Sarawak was 200310, constant  $k$  11,128, then the ordered list of school to be divided into 18 blocks where one block would consist of 10-11 schools. Finally, one school was randomly selected from each of the blocks.

Using a bilingual language (Malay language and English) questionnaire, socio-demographic profile (age, gender and ethnicity), medical history, parental history of hypertension and physical activity information was gathered.

Physical activity level was calculated based on the frequency and duration of physical activity in a week, multiplied with the physical activity metabolic equivalent (MET) derived from 2011 Compendium of Physical Activities: A second updates of codes and MET.<sup>14</sup>

For anthropometric measurement, height and weight were measured using SECA body meter and portable weighing scale. When measuring the height, the respondents were asked to stand upright barefooted on a flat surface with their back of the heels and occiput against the body meter. The height was measured to the nearest 0.1cm. On the other hand, prior to measuring the weight, the respondents were asked to remove their shoes and excess clothing. The weight was measured to the nearest 0.1 kg. Body mass index was

calculated and classified into thinness, normal, overweight, and obese based on age and gender using WHO 2007 reference.<sup>15</sup>

Body fat was measured using Tanita Karada Scan body composition analyzer. Using the Tanita body fat percentage reference table for Asian adolescents based on age and gender, classification of underfat, overfat and obese was carried out.<sup>16</sup>

For waist circumference (WC), using tape to the nearest 0.1cm, measurement was taken by locating the top of hip bone (iliac crest) before any measurement is taken. Prior to taking the measurement, the respondents were asked to relax their abdomen and stand upright. The measurement was taken at the end of expiration. For waist circumference, the cut-off points for abdominal obesity was based on Malaysian Adolescents Reference Table by Poh<sup>17</sup> where waist circumference above 90<sup>th</sup> percentile based on age and gender was classified as centrally obese.

For blood pressure measurement, a digital blood pressure monitor was used. Respondents were asked not to take any medications, caffeine or exercise to prevent false reading. Measurement was taken after a rest of at least 5 minutes. Two measurements were taken at an interval of one minute, from which their average value was calculated. In case of the difference between the two readings exceeded 5 mm Hg, one additional reading was taken, and the average of the three readings was used.<sup>18</sup> Pre hypertension and hypertension was classified according to 4<sup>th</sup> Report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents<sup>17</sup> where cutoff point was based on age, gender and height.

Only those healthy respondents with no physical and mentally disability, pre-diagnosed hypertension and any illness that could lead to secondary hypertension were invited to participate in this study.

Consent and cooperation was sought from Ministry of Education, schools and all respondents' parents. Ethics approval was

obtained from the Medical Ethics committee of the university. Respondents' participations were completely voluntary and confidential. All the data collected remained anonymous and confidential except to the researchers and research assistant who were involved directly in this study.

Statistical analysis was performed using Statistical Package for Social Sciences Program (SPSS) version 22.0. The data was coded and entered into SPSS data file for descriptive and inferential analysis. The level of significance was set at 5% (2 sided). An initial analysis was conducted to determine the need to carry out separate analysis for both rural and urban models. Multinomial logistic regression analysis was carried out to determine the predictors for both rural and urban models based on normal, pre-hypertension and hypertension as dependent variables.

## **Results**

A total of 2461 secondary school children participated in the study (response rate of 97.7%) with 58.0% females, achieving the target sample size of 2000 to 2500 respondents. 21.5% reported at least one parent with a history of hypertension. The prevalence of pre-hypertension was 13.2%, stage 1 hypertension was 12.4% and stage 2 hypertension was 4.6%. The prevalence of overweightness and obesity was 24.3%, elevated waist circumference was 13.5%, and overfat and obese was 6.7%. Higher prevalence of pre-hypertension and hypertension was found in urban areas as compared to rural areas. The prevalence of hypertension (stage 1 or 2) among male respondents was 9.4% and female respondents was 7.5%. Table 1 and 2 shows the socio-demographic characteristics and nutritional status of the respondents according to location. There were significant differences in age, gender, ethnicity, waist circumference, systolic blood pressure,

diastolic blood pressure, hypertension between urban and rural areas. The significant difference in hypertension between urban and rural areas had further confirmed that a separate model should be carried out for each locality to elucidate the factors contributing to hypertension.

Table 3 and 4 show the results of the final multinomial logistic model for both urban and rural respondents. Based on the urban model (adjusted for age), the following factors were associated with pre-hypertension: male (OR=3.61, 95% CI: 2.01,6.11), parent with history of hypertension (OR=1.85, 95% CI:1.06,3.24), overweightness and obesity (OR=2.33, 95% CI: 1.22,4.55). However, at the hypertension level, only male (OR=2.70, 95% CI:1.64,4.45), overweight and obese (OR=2.96, 95% CI:1.61, 5.26) were found to be associated. In addition, a higher odds ratio was found for elevated waist circumference of 4.42 (95% CI:1.75,11.11) to be associated with hypertension. In the rural model (adjusted for age), five factors were found to be associated with pre-hypertension: male (OR=3.88, 95% CI:2.80,5.36), ethnic group (Chinese) (OR=1.95, 95% CI:1.11, 3.44), overweight and obese (OR=1.83, 95% CI:1.12, 2.94), elevated waist circumference (OR=2.54, 95% CI:1.38, 4.54). Similarly with pre- hypertension level, few variables which were consistently associated with hypertension were male gender (OR=2.7, 95% CI:1.87,3.68), ethnic group (Iban and Chinese) (OR=1.98, 95% CI:1.19,3.30; OR=2.43, 95% CI:1.34,4.40), overweight and obese (OR=5.29, 95%CI:3.57,7.69), elevated waist circumference (RRR=1.63, 95%CI:0.38,0.99), with additional of parent with history of hypertension (OR=1.49, 95%CI:1.07,2.07), overfat and obese (OR=2.72, 95%CI:1.56,4.76). It was interesting to note that male, overweight and obese were consistently appeared to be the factors associated with pre-hypertension and hypertension for both urban and rural respondents.

**Table 1.** Socio-demographic characteristics of the respondents according to location (N=2461)

	Overall (n=2461)		Urban (n=634)		Rural (n=1827)		<i>p</i> *
	n (%)	Mean (SD)	n (%)	Mean (SD)	n (%)	Mean (SD)	
<b>Age (year)</b>		14.5 (1.50)		14.3 (1.46)		14.5 (1.51)	<0.00 0
>12 but below 13 years	255 (10.4)		75 (29.4%)		180 (70.6)		<0.00 0
13-15 years	1469 (59.7)		413 (28.1)		1056 (71.9)		
16-17 years	737 (29.9)		146 (19.8)		591 (80.2)		
<b>Gender</b>							
Male	1033 (42.0)		306 (29.6)		727 (70.4)		<0.00 0
Female	1428 (58.0)		328 (23.0)		1100 (77.0)		
<b>Ethnic group</b>							
Iban	737 (29.9)		122 (16.6)		615 (83.4)		<0.00 0
Malay	681 (27.7)		176 (25.8)		505 (74.2)		
Chinese	475 (19.3)		259 (54.5)		216 (45.5)		
Bidayuh	256 (10.4)		24 (9.4)		232 (90.6)		
Others	312 (12.7)		53 (17.0)		259 (83.0)		
<b>Parent's history in hypertension</b>							
Yes, one of the parents	448 (18.2)		104 (23.2)		344 (76.8)		0.347
Yes, both parents	80 (3.3)		23 (28.8)		57 (71.3)		
No	1933 (78.5)		507 (26.2)		1426 (73.8)		

\*Chi-Square test

**Table 2.** Nutritional profile of the respondents according to location (N=2461)

	Overall (n=2461)		Urban (n=634)		Rural (n=1827)		p
	n (%)	Mean (SD)	n (%)	Mean (SD)	n (%)	Mean (SD)	
<b>Body Mass index</b>		21.5 (4.76)		21.3 (4.50)		21.5 (4.85)	0.395 <sup>a</sup>
Normal	1863 (6.1)		482 (76.0)		1381 (75.6)		0.872 <sup>b</sup>
Overweight & obese	598 (24.3)		152 (24.0)		446 (24.4)		
<b>Waist circumference</b>		70.6 (15.94)		70.8 (25.35)		70.6 (10.93)	0.843 <sup>a</sup>
Normal	2128 (86.5)		567 (89.4)		1561 (85.4)		0.006 <sup>b</sup>
Centrally obese	333 (13.5)		67 (10.6)		266 (14.6)		
<b>Body fat %</b>		21.2 (6.82)		20.8 (6.68)		21.2 (6.87)	0.135 <sup>a</sup>
Normal	2296 (93.3)		595 (93.8)		1701 (93.1)		0.293 <sup>b</sup>
Overfat & Obese	165 (6.7)		39 (6.2)		126 (6.9)		
<b>Systolic blood pressure</b>		114.1 (13.26)		115.5 (13.30)		113.6 (13.19)	0.001 <sup>a</sup>
<b>Diastolic blood pressure</b>		65.5 (9.28)		66.2 (9.78)		65.3 (9.08)	0.033 <sup>a</sup>
<b>Blood pressure</b>							
Normal	1720 (69.6)		415 (65.5)		1305 (71.4)		0.025 <sup>b</sup>
Pre-hypertension	324 (13.2)		100 (15.8)		224 (12.3)		
Hypertension	417 (17.0)		119 (18.8)		298 (16.3)		
<b>Physical activity</b>							
Inactive	1429 (58.1)		370 (58.4)		1059 (58.0)		0.450 <sup>b</sup>
Active	1032 (41.9)		264 (41.6)		768 (42.0)		

<sup>a</sup>independent t-test; <sup>b</sup>Chi-Square test

**Table 3.** Multivariate Multinomial Logistics Regression Model Investigating Predictors of Pre-hypertension and Hypertension (Urban model)

Characteristic	Categories	Urban			
		Pre-hypertension		Hypertension	
		OR (95% CI)	P value	OR (95% CI)	P value
Sex	Male	3.61 (2.13,6.11)		2.70 (1.64,4.45)	<0.0001
	Female	Reference group			
Ethnic group	Iban				
	Chinese				
	Malay				
	Others				
	Bidayuh	Reference group			
Parent with history of hypertension	Yes	1.85 (1.06, 3.24)	0.031		
	No	Reference group			
Body Mass Index	Normal	Reference group			
	Overweight and obese	2.33 (1.22,4.55)	0.011	2.96 (1.61,5.26)	<0.0001
Waist circumference	Normal	Reference group			
	Centrally obese			4.42 (1.75, 11.11)	0.001
Body fat	Normal	Reference group			
	Overfat and Obese				

Adjusted for age; OR= Odds Ratio



**Table 4.** Multivariate Multinomial Logistics Regression Model Investigating Predictors of Pre-hypertension and Hypertension (Rural model)

Characteristic	Categories	Rural			
		Pre-hypertension		Hypertension	
		OR (95% CI)	P value	OR (95% CI)	P value
Sex	Male	3.88 (2.80,5.36)	<0.0001	2.70 (1.97, 3.68)	<0.0001
	Female				
Ethnic group	Iban			1.98 (1.19,3.30)	0.009
	Chinese	1.95 (1.11,3.44)	0.021	2.43 (1.34,4.40)	0.003
	Malay				
	Others				
	Bidayuh				
Parent with history of hypertension	Yes			1.49 (1.07,2.07)	0.017
	No				
Body Mass Index	Normal				
	Overweight and obese	1.83(1.12, 2.94)	0.014	5.29 (3.57, 7.69)	<0.0001
Waist circumference	Normal				
	Centrally obese	2.54 (1.38, 4.54)	0.002	1.63 (1.01,2.63)	0.044
Body fat	Normal				
	Overfat and Obese			2.72 (1.56,4.67)	<0.0001

Adjusted for age; OR= Odds Ratio

### Discussion

This study was designed to determine the factors associated with pre-hypertension and hypertension among adolescents aged 12-17 years in urban and rural communities of Sarawak, Malaysia. This study is a preliminary attempt to gain an insight to the prevalence of pre-hypertension and hypertension among

the adolescence population of Sarawak and its epidemiological trends. Although the prevalence of hypertension continues to rise in Malaysia, it remains widely unreported at the state level compared to the existing findings at the national level. The findings of this study could be useful in the planning and developing of intervention programs for both

prevention and control of cardiovascular disease related to hypertension.

The study indicated that the prevalence of pre-hypertension and hypertension for the whole study population was 13.2% and 17.0%. These findings are not different from local studies where the prevalence of hypertension among urban adolescence in Peninsular Malaysia was 11.6% to 33.1%.<sup>9,19</sup> In developing countries such as Nigeria and Ghana, the prevalence of pre-hypertension can be as high as 32.3 to 33.2%, however the prevalence of hypertension remains as low as 4.0 – 4.4%.<sup>20,21</sup> Despite having lower prevalence of hypertension than other studies, adolescent pre-hypertension is a strong predictor of hypertension in adults<sup>22</sup>, and its progression from pre hypertension was found to be fast among certain ethnic groups, such as African Americans in the USA.<sup>23</sup> In an urban and rural comparison, higher prevalence of pre-hypertension and hypertension was found in urban areas in this study, consistent with findings of other studies elsewhere.<sup>24</sup> This suggests that the lifestyle in urban areas remains the contributing factor to increasing prevalence of hypertension. Adolescents in the rural areas are not totally protected from elevation of blood pressure where the prevalence for pre-hypertension was reported to be 12.1% and hypertension 16.3%, indicating a potential public health burden among the rural communities.

After adjusting for age, male, overweight and obese remained the contributing factor for all models (both urban and rural, and pre-hypertension and hypertension). This study revealed that males had higher prevalence of elevated blood pressure than females, consistent with other studies<sup>20,21,24</sup>. Although there was no significant difference in overweight and obese between males and females in both urban and rural area, there was a slightly higher prevalence of overweight and obese among males (25.5%) compared to females (23.5%). This may indicate there is an association between elevated blood pressure and obesity.

The effect of body mass index on high blood pressure has been evidenced in many studies<sup>3,7</sup>. The urban and rural respondents in this study were reported to have a prevalence of overweight and obesity of 24.0 to 24.4%. This may be due to the availability of high fat diet and sedentary lifestyles. Progress of urbanization has contributed to higher socio-economic activities which improve the standard of living of rural dwellers. However, improvement of socio-economic status may also encourage the adaptation of unhealthy lifestyles.

Our result showed that waist circumference was a significant factor contributing to pre-hypertension for rural respondents and hypertension for both urban and rural respondents. Visceral fat as measured by waist circumference can be a good predictor for elevated blood pressure, as demonstrated by Lee et al.<sup>23</sup> that waist circumference has a strong correlation with systolic and diastolic blood pressure among obese children. It was further explored by Burgos et al.<sup>26</sup> that visceral fat exerts greater influence in systolic blood pressure compared to diastolic blood pressure.

Parent's history with hypertension is another important factor that was found to be significantly associated with pre-hypertension in urban area and hypertension in rural area. The odds ratio was found to be below 2 times (1.85 times and 1.49 times respectively). Family history of hypertension is an important non-modifiable risk factor for elevated blood pressure, evidenced in many family studies<sup>27</sup>, where positive family history was found to double the risk for elevated blood pressure compared to those with negative family history. It was explained that such a pattern was found due to increased proximal renal sodium reabsorption, genetic traits that involves high sodium-lithium counter-transport, high uric acid, and elevated plasma insulin concentration<sup>27,28</sup>. Therefore, adolescents with hypertensive parents should be screened earlier and closely monitored.

Among the ethnic groups, Iban and Chinese respondents had the highest prevalence of pre-hypertension, hypertension, overweight and obese, and centrally obese. One possible explanation is higher prevalence of elevated blood pressure was associated with higher prevalence of overweight and obese and elevated visceral fat. This finding is consistent with the adult study carried out by Rampal et al<sup>8</sup> where higher prevalence of elevated blood pressure was observed among the indigenous Sarawakian (including Iban) and Chinese. Although there is uncertainty as to how such a difference was observed for both adolescents and adults, the findings indicate that there is an increasing trend towards hypertension among the indigenous and Chinese adolescents in Sarawak as they age into adulthood. Interestingly, the findings indicate a higher prevalence of hypertension among Iban and Chinese in rural areas, but such findings were not present in the urban areas. This observation was consistent with a study by Ahmed et al<sup>29</sup> where the researchers believe it could be attributed to a rise in urbanized life-style in the rural communities, particularly the increase of fast food outlets and availability of high calories foods. And it was also found out the prevalence of overfat, overweight and obesity, centrally obese was high among rural Iban respondents.

Due to the nature of cross-sectional study, this study was not able to analyze the cause and effect relationship between the independent and dependent variables. In addition, the ascertainment of elevated blood pressure was based on one visit; therefore, results need to be interpreted with caution.

## **Conclusion**

In conclusion, although the prevalence of pre-hypertension and hypertension was found to be different between urban and rural areas, gender and obesity were found to be associated with elevated blood pressure regardless. Nevertheless, other factors such as age, central-obesity, parent with hypertension, ethnicity and overfat should be

taken into consideration as well in future intervention. Due to the fact that hypertension in adolescents can proceed to adulthood, there is a need to emphasize earlier detection and intervention among adolescents.

## **Acknowledgement**

We are grateful to all participants, teachers and the relevant authorities who have supported and made this research successful.

## **Declarations**

This is to inform that we do not have any conflicts of interest in relation to the above research. The project was conducted in accordance to ethics guidelines established for human subjects and animal welfare. We also agreed to transfer all the copyrights to the journal for publication. This manuscript is our own work, it is not under consideration by another journal, and this material has not been previously published.

## **Authors' contributions**

CWL, CCT, and HH conceived of the project and designed the research component. CWL, CCT and GKWF supervised the implementation of the field research and data management. CWL and HH performed the statistical analyses. CWL drafted the manuscript, with inputs from CCT, HH, and GKWF. All authors read and approved the final version of the manuscript.

Conflict of interest: No competing interests.

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## **Consent for publication**

Participants' consent was obtained for the purposes of publishing the findings from the study. All the authors consented to the study results to be published in the form presented in the final version of this manuscript.

Ethics approval and consent to participate

Consent and cooperation was sought from Ministry of Education, schools and all respondents' parents. Ethics approval was obtained from the Medical Ethics committee of the university [UNIMAS/NC-21.02/03-02(71)]. Respondents' participations were completely voluntary and confidential.

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