

Association Between Psychosocial Stress Factors and Elevated Blood Pressure in Children and Adolescents in Ibadan, South-West Nigeria

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Abstract

Background

Hypertension is increasingly recognized as a public health concern among adolescents, particularly in low and middle-income countries where exposure to psychosocial and socioeconomic stressors is widespread. Early identification of risk factors, including modifiable psychosocial influences, is crucial for halting the progress of elevated blood pressure into hypertension in adulthood. This study investigated the association between psychosocial stress and elevated blood pressure in children and adolescents in Ibadan, southwest Nigeria.

Methods

A descriptive cross-sectional study was carried out among 335 children and adolescents aged 8-14 years. Data were collected using a pre-tested, semi-structured, interviewer-administered questionnaire that assessed exposure to psychosocial stress factors and clinical measurements of blood pressure. Data were analyzed using descriptive statistics, and associations explored using Pearson's and Mantel-Haenszel chi-square tests.

Results

The overall prevalence of psychosocial stress was 51.3%. Overall blood pressure status was statistically significantly associated with stress in home life ($\chi^2 = 8.134, p = 0.006$), social relation ($\chi^2 = 4.919, p = 0.036$) and future uncertainty ($\chi^2 = 5.100, p = 0.028$). Overall psychosocial stress was also statistically associated with overall blood pressure status ($\chi^2 = 7.943, p = 0.005$). In stratified analysis, age was associated with home life stress ($p = 0.005$), social relation ($p = 0.021$), future uncertainty ($p = 0.014$) and financial hardship ($p = 0.047$). Sex was also significantly associated with homelife ($p = 0.007$), social relation ($p = 0.029$), and future uncertainty ($p = 0.030$).

Conclusion

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) measurement are affected differentially by psychosocial stress at different domains. Psychosocial stress also shows significant association with the overall elevated blood pressure at different domains. These findings highlight the importance of psychosocial interventions targeted at adolescents, especially those experiencing socioeconomic and family-related stressors.

INTRODUCTION

Normal blood pressure is traditionally defined as blood pressure values which is less than the 90th percentile systolic blood pressure (SBP) and diastolic blood pressure (DBP) for age, gender, and height. Elevated blood pressure is therefore defined as greater than or equal to the 90th percentile and less than the 95th percentile for SBP and/or DBP for age, gender, and height. Pre-hypertension is defined as blood pressure greater than or equal to 120/80mmHg. Hypertension was defined as average clinic-measured SBP and/or DBP higher than or equal to the 95th percentile for age, gender, and height, or more than 130/80 mmHg in adolescents. Elevated blood pressure can be categorized into three stages: high blood pressure, stage 1 hypertension, and stage 2 hypertension. [1].

According to the World Health Organization, hypertension affects around 1.28 billion people worldwide, with two-thirds of this population living in low- and middle-income nations [2]. Over the past three decades, hypertension has transitioned from a being a significant burden only in high-income countries (HICs) to include low-and middle -income countries [3]. Reports in the last five years shows that low-and middle-income countries now account for up to 80% of the burden of hypertension [4].

Adolescents constitute approximately 16% of the global population and 31% of the population in Sub-Saharan Africa [5, 6]. Studies assessing the global prevalence of adolescent hypertension have reported estimates ranging from 2% to 10%, depending on population and criteria used [7, 8]. A meta-analysis study conducted in Africa revealed a pooled prevalence ranging from 0.2% to 24.8% [9]. A systematic review of a study conducted in Nigeria among adolescents reported hypertension prevalence rates ranging from 2.4% to 25.1% [10]. Onyeji et al (2023) in Nigeria had reported a 9.9% prevalence of elevated blood pressure among adolescents in Ebonyi, a south eastern State, in Nigeria [11]. This variation is attributed to differences in regional demographics, measurement techniques, and study designs. The increasing prevalence of hypertension in adolescents reflects the broader epidemiological transition toward non-communicable diseases. This trend is particularly alarming given that elevated blood pressure in adolescence often tracks into adulthood, substantially increasing the risk of cardiovascular disease, stroke, and kidney disorders [12, 13].

Hypertension has a complex, multifactorial aetiology involving genetic factors, dysfunction in some biochemical and physiological regulatory processes, and lifestyle factors [14]. Stress can cause hypertension through repeated blood pressure elevation as well as by stimulation of the nervous system to produce large amounts of vasoconstricting hormones that increase blood pressure during childhood and adolescence [15]. These stressors activate the sympathetic nervous system and hypothalamic-pituitary-adrenal (HPA) axis, resulting in the sustained secretion of cortisol and dysregulation of the autonomic nervous system, contributing to elevated blood pressure, endothelial dysfunction, and altered vascular tone [13, 16, 17, 18]. There is considerable evidence that shows unpleasant stimuli elicit transient increases in blood pressure in both children and adolescents. This response, however, diminishes once the stress-causing agent is terminated or removed. The persistent activation of these stress hormones can exert a cumulative toll on physiological systems, particularly the cardiovascular and neuroendocrine systems, increasing the risk of developing hypertension over time. Also, the

intensity and duration of exposure to stress have been presumed to be important determinants of the risk of elevated blood pressure.

Psychosocial stress refers to the psychological and social pressures that arise when individuals perceive that the demands of their environment exceed their ability to cope leading to emotional, cognitive and physiological responses. Psychosocial stress can arise from a variety of causes and events, such as financial hardship, academic stress, peer pressure, social relations, home life stress, teachers' interaction, and future uncertainty. The feeling of stress and its consequences are frequently unique to each person. Psychosocial stress can be acute or chronic, and the duration of the stress reaction influences the incidence and type of CVD outcomes [19]. Many adolescents are faced with different psychosocial stressors such as academic pressure, family-related trauma, and much more. Although some literature has established the association between psychosocial stress and hypertension among adult population, little or no sufficient research has been done among the children and adolescents' population.

Investigating the role of psychosocial stress factors in childhood hypertension align with global health priorities. Adolescent with high exposure to chronic psychosocial stress is more likely to have elevated blood pressure. Early detection contributes to lower morbidity, mortality and disability adjusted life years (DALYs), to prevent long-term complications and health cost. Preventive approaches will represent a cost-effective strategy for government and health stakeholders. Therefore, research on psychosocial stress of elevated blood pressure among children and adolescents will inform policy making, structured stress-management and counselling programs particularly in schools and also improve population health outcome. This study aimed to assess the association between psychosocial stress and elevated blood pressure among children and adolescents in Ibadan, south-west, Nigeria.

Methodology

Study Area

Ibadan, the capital of Oyo State, is the most populous city in the state and ranks as the third-largest city in Nigeria, after Lagos and Kano. The city has an estimated metropolitan population of approximately four million, according to projections from the National Population Commission. Administratively, Ibadan is made up of 11 local government areas (LGAs), comprising five urban and six rural LGAs. Ibadan encompasses communities with wide variations in socio-economic status. The urban LGAs include Ibadan North, Ibadan North-West, Ibadan North-East, Ibadan South-West, and Ibadan South-East, while the rural LGAs are Akinyele, Lagelu, Egbeda, Ona-Ara, Oluyole, and Ido. The city is served by several tertiary healthcare institutions, including the University College Hospital (UCH), one of Nigeria's leading teaching hospitals, Adeoyo Maternity Teaching Hospital, and Lead City Teaching Hospital, alongside numerous general hospitals, primary health centres, and private clinics. The educational landscape in Ibadan comprises both public and private schools that serve children from diverse socio-economic backgrounds. Public schools are more commonly attended by children from lower-income households,

whereas private schools predominantly serve families with higher income levels. These differences in educational access mirror broader inequalities in parental education, occupation, and living conditions, which are important sociodemographic factors in understanding childhood hypertension.

Study Design and Duration

A descriptive cross-sectional study of children and adolescents aged 8 to 14 years residing in selected communities in both rural and urban settlements of Ibadan, Oyo State, during the period of May and November 2025.

Study Population

The target population for this study were children and adolescents between the ages of 8 and 14 years residing in the selected communities within Ibadan North, Ibadan Northwest, Lagelu, and Ido local government areas. The communities were selected to ensure representation across different socioeconomic strata and residential settings (urban and rural).

Eligibility Criteria

Inclusion Criteria

Children and adolescents aged 8 to 14 years, and those whose parents/guardians provided written informed consent, while adolescents above 12 years of age provided individual assent prior to the start of the questionnaire administration.

Exclusion Criteria

Children and adolescents with known chronic illnesses (e.g., renal or cardiac disease) that may affect blood pressure of children and adolescents are currently on medication known to influence blood pressure.

Sample Size Determination

Sample size for the study was calculated using Cochran's formula for estimating the sample size for a single proportion ($n = z^2pq / d^2$). The prevalence (p) of elevated blood pressure among children and adolescents that was used is 26.7% [20], with z = standard normal deviation for the desired confidence level (1.96), and d is the degree of accuracy (0.05). Therefore, the estimated sample size was 335 respondents

Sampling Procedure

Participants were selected using a multistage sampling technique. In first stage, list of all local governments in Ibadan was obtained, which comprises 11 local government areas Ibadan North, Ibadan North-West, Ibadan North-East, Ibadan South-West, Ibadan South-East, Akinyele, Lagelu, Egbeda, Ona-Ara, Oluyole, and Ido. The local government was stratified into urban which comprises of Ibadan north, Ibadan north-west, Ibadan North-East, Ibadan South-West, Ibadan South-East and rural LGAs which comprises of Ido, Lagelu, Egbeda, Ona-Ara, Akinyele, and Oluyole. From each stratum, two urban LGAs (Ibadan north and Ibadan north-west) and two rural LGAs (Ido and Lagelu) were randomly selected via balloting. In each selected LGA, communities such as Yemetu, Adeoyo, Agbowo, Sango in Ibadan north, Opoo, in Ibadan north-west, Oke Adu, Oke Aremu, Sapati, Kute, Olowu in Lagelu and Siba in Ido were purposely selected based on the accessibility of children and adolescents and population distribution. In the second stage, A house-to-house survey was conducted in the selected communities. Systematic sampling was used to select households. A sampling starting point was determined with a random starting point, and every third household was selected until the required sample size was achieved. Lastly, in households with more than one eligible child and adolescent, simple random sampling via balloting was used to select up to two children or adolescents per household. Each eligible child or adolescent's name or number was placed in a lottery, and a child or adolescent was selected by balloting. This ensured wider representation across households while preventing over-representation from any single household.

Instrument and Data Collection Methods

Data were collected using a pre-tested, semi-structured, interviewer-administered questionnaire to obtain information on sociodemographic characteristics, pattern of elevated blood pressure, and psychosocial stress factors. This questionnaire was administered only in English because it is the official language of instruction in Nigerian education sector. Consequently, no translation of the questionnaire into any local language was required or performed.

Blood pressure measurement: BP readings were obtained using an automated digital blood pressure monitor ("ANDON") with a paediatric cuff size (17–22 cm) suitable for children and adolescents' arm circumference. Each participant undergoes two measurements of blood pressure, taken five minutes apart, on the right arm. If two readings differ by more than 5mmHg, a third reading was taken. The average of the two closest readings was recorded as the blood pressure. Blood pressure was classified following the 2017 American Academy of Pediatrics (AAP) [1] pediatric hypertension guideline. For children aged < 13 years, blood pressure categories were defined using age-, sex-, and height-specific percentiles: normal (< 90th percentile), and elevated BP ($\geq$ 90th to < 95th percentile). For adolescents aged $\geq$ 13 years, fixed thresholds were applied (normal < 120/<80 mmHg, elevated BP 120–129/<80 mmHg). Screening BP values from the AAP simplified table were used to identify participants requiring further evaluation.

A standardized and validated Adolescent Stress Scale Questionnaire (ASQ) adapted from Byrne et al. [27], and comprises of a 37-item inventory question was used. This instrument has been validated and

used among adolescents across various parts of the world, including Greek, Germany, Hungary, Spain and Denmark [24, 25]. The adolescent stress scale questionnaire has also been adapted in different cultural settings such as Greece, New Zealand and Spain. Each item in the question has a total score of 2. It is categorised into not stressful, a little stressful, and very stressful. This is then re-categorised into low stress and very stress. For each stress domain, home life stress is assessed using 6-item questions having a maximum score of (12). Scores between (0–6) represent low stress, and (7–12) represent very stress. Social relations are assessed using 4-item questions having a maximum score of (8). Scores between (0–4) represent low stress, and (5–8) represent very stress. Academic stress is assessed using 7-item questions having a maximum score of (14). Scores between (0–7) represent low stress, and (8–14) represent very stress. Peer pressure stress is assessed using 5-item questions having a maximum score of (10). Scores between (0–5) represent low stress, and (6–10) represent very stress. Teacher interaction is assessed using 5-item questions having a maximum score of (10). Scores between (0–5) represent low stress, and (6–10) represent very stress. Future uncertainty is assessed using 3-item questions having a maximum score of (6). Scores between (0–3) represent low stress, and (4–6) represents very stress, while financial hardship is assessed using 7-item questions having a maximum score of (14). Scores between (0–7) represent low stress, and (8–14) represent very stress. The overall total score of the psychosocial stress domain, having 37-items is (74). Scores between (0–37) represent low stress, and (38–74) represent very stress.

Data Analysis

Statistical analysis was performed using SPSS version 27. Descriptive analysis was conducted to determine the frequency and percentage of socio-demographic characteristics and prevalence of the psychosocial stress domain. Bivariate analysis was conducted using the Pearson chi-square to determine the association between psychosocial stress category and blood pressure status. The t-test was also used to assess the differences in means of the continuous variables. Stratified analysis was used to account for age and sex as confounders using Mantel-Haenszel chi-square, and the corresponding p-values set at < 0.05 were reported.

Results

Table 1 presents the prevalence of psychosocial stress across the stress domain. Adolescents reported prevalence of psychosocial stress by domains as follows: home life stress (n = 148, 44.2%), social relations (n = 126, 37.6%), academic stress (n = 156, 46.6%), teachers’ interaction (n = 124, 37.0%), future uncertainty (n = 137, 40.9%), and financial hardship (n = 164, 49.0%). The overall prevalence of psychosocial stress across the stress domain is 172 (51.3%).

Table 1
Prevalence of psychosocial stress factors

Psychosocial Stress	Category	Frequency (n)	Percentages (%)
Home Life	Yes (7–12)	148	44.2
	No (0–6)	187	55.8
Social relation	Yes (5–8)	126	37.6
	No (0–4)	209	62.4
Academic stress	Yes (8–14)	156	46.6
	No (0–7)	179	53.4
Peer pressure	Yes (6–10)	124	37.0
	No (0–5)	211	63.0
Teacher interaction	Yes (6–10)	146	43.6
	No (0–5)	189	56.4
Future uncertainty	Yes (4–6)	137	40.9
	No (0–3)	198	59.1
Financial hardship	Yes (8–14)	164	49.0
	No (0–7)	171	51.0
Overall stress prevalence	Yes (38–74)	172	51.3
	No (0–37)	163	48.7

Table 2 presents the association between various psychosocial stress factors and systolic blood pressure among adolescents. The chi-square analysis revealed that financial hardship had a statistically significant association with elevated systolic blood pressure ($\chi^2 = 4.804$, $p = 0.028$). This indicates that adolescents who experienced financial hardship were more likely to have elevated systolic blood pressure compared to those who did not, this shows financial hardship had more influence on the cardiac output and sympathetic nervous system activation. On the other hand, homelife stress ($\chi^2 = 2.277$, $p = 0.108$), social relations ($\chi^2 = 3.626$, $p = 0.057$), academic stress ($\chi^2 = 2.369$, $p = 0.124$), peer pressure ($\chi^2 = 0.00$, $p = 0.987$), teacher's interaction ($\chi^2 = 1.374$, $p = 0.241$) and future uncertainty ($\chi^2 = 3.727$, $p = 0.054$) showed no significant association with systolic blood pressure, though social relations and future uncertainty approached significance level.

Table 2
Association between psychosocial stress factors and systolic blood pressure (SBP)

Psychosocial stress factors	Normal SBP n (%)	Elevated SBP n (%)	χ^2	df	p-value
Homelife	163(87.2)	24(12.8)	2.277	1	0.108
Not stressful	137(92.6)	11(7.4)			
Stressful					
Social relation	182(87.1)	27(12.9)	3.626	1	0.057
Not stressful	118(93.7)	8(6.3)			
Stressful					
Academic stress	156(87.2)	23(12.8)	2.369	1	0.124
Not stressful	144(92.3)	12(7.7)			
Stressful					
Peer pressure	189(89.6)	22(10.4)	0.00	1	0.987
Not stressful	111(89.5)	13(10.5)			
Stressful					
Teachers' interaction	166(87.8)	23(12.2)	1.374	1	0.241
Not stressful	134(91.8)	12(8.2)			
Stressful					
Future uncertainty	172(86.9)	26(13.1)	3.727	1	0.054
Not stressful	128(93.4)	9(6.6)			
Stressful					
Financial Hardship	147(86.0)	24(14.0)	4.804	1	0.028
Not stressful	153(93.3)	11(6.7)			
Stressful					

Table 3 presents the association between various psychosocial stress factors and diastolic blood pressure among adolescents. Home life stress had a statistically significant association with elevated diastolic blood pressure ($\chi^2 = 6.826$, $p = 0.009$), this reflect that Homelife stress has effect on the peripheral vascular resistance and vascular tone. On the other hand, social relations ($\chi^2 = 2.647$, $p = 0.104$), academic stress ($\chi^2 = 1.307$, $p = 0.253$), peer pressure ($\chi^2 = 0.076$, $p = 0.782$), teacher's interaction ($\chi^2 = 2.570$, $p = 0.109$) and future uncertainty ($\chi^2 = 2.257$, $p = 0.133$) and financial hardship ($\chi^2 = 1.457$, $p = 0.487$)

= 0.227) showed no significant association with diastolic blood pressure, though social relations and future uncertainty approached significance level.

Table 3
Association between psychosocial stress factors and Diastolic blood pressure (DBP)

Psychosocial stress factors	Normal DBP n (%)	Elevated DBP n (%)	χ^2	df	p-value
Homelife	150(80.2)	37(19.8)	6.826	1	0.009
Not stressful	134(90.5)	14(9.5)			
Stressful					
Social relation	172(82.3)	37(17.7)	2.647	1	0.104
Not stressful	112(88.9)	14(11.1)			
Stressful					
Academic stress	148(82.7)	31(17.3)	1.307	1	0.253
Not stressful	136(87.2)	20(12.8)			
Stressful					
Peer pressure	178(84.4)	33(15.6)	0.076	1	0.782
Not stressful	106(85.5)	18(14.5)			
Stressful					
Teachers' interaction	155(82.0)	34(18.0)	2.570	1	0.109
Not stressful	129(88.4)	17(11.6)			
Stressful					
Future uncertainty	163(82.3)	35(17.7)	2.257	1	0.133
Not stressful	121(88.3)	16(11.7)			
Stressful					
Financial Hardship	141(82.5)	30(17.5)	1.457	1	0.227
Not stressful	143(87.2)	21(12.8)			
Stressful					

Table 4 presents a chi-square analysis to examine the association between psychosocial stress factors and overall blood pressure status among adolescents. The findings indicate that there was a statistically significant association between psychosocial stress factors such as home life stress ($\chi^2 = 8.134, p = 0.006$), social relations ($\chi^2 = 4.919, p = 0.036$), and future uncertainty ($\chi^2 = 5.100, p = 0.028$). The

association between overall psychosocial stress and overall blood pressure status also indicates a significant association ($\chi^2 = 7.943, p = 0.005$).

Table 4
Association between psychosocial stress factors and overall blood pressure status

Source and level of Psychosocial stress	Normal BP n (%)	Elevated BP n (%)	χ^2	df	p-value
Home life stress	138(73.8)	49(26.2)	8.134	1	0.006
Not Stressful	128(86.5)	20(13.5)			
Stressful					
Social relation	158(75.6)	51(24.4)	4.919	1	0.036
Not Stressful	108(85.7)	18(14.3)			
Stressful					
Academic stress	136(76.0)	43(24.0)	2.758	1	0.105
Not Stressful	130(83.3)	26(16.7)			
Stressful					
Peer pressure	167(79.1)	44(20.9)	0.023	1	0.890
Not Stressful	99(79.8)	25(20.2)			
Stressful					
Teacher interaction	144(76.2)	45(23.8)	2.737	1	0.104
Not Stressful	122(83.6)	24(16.4)			
Stressful					
Future uncertainty	149(75.3)	49(24.7)	5.100	1	0.028
Not Stressful	117(85.4)	20(14.6)			
Stressful					
Financial hardship	129(75.4)	42(24.6)	3.357	1	0.079
Not Stressful	137(83.5)	27(16.5)			
Stressful					
Overall stress Status	119(73.0)	44(27.0)	7.943	1	0.005
Not stressful	147(85.5)	25(14.5)			
Stressful					

Table 5 presents a stratified analysis to examine the association between psychosocial stress factors and overall elevated blood pressure while controlling for potential confounding by age group using the Mantel-Haenszel method. After adjustment for age group (< 9 years and 10–14 years), several psychosocial stress factors demonstrated statistically significant associations with overall elevated blood pressure. Home life stress shows a significant association with elevated blood pressure ($\chi^2 = 7.488$, $p = 0.005$). Similarly, social relations were significantly associated with overall elevated blood pressure ($\chi^2 = 4.795$, $p = 0.021$). Future uncertainty also showed a significant association after age adjustment with elevated blood pressure ($\chi^2 = 5.455$, $p = 0.014$). In addition, financial stress also shows a significant association with elevated blood pressure ($\chi^2 = 0.047$, $p = 0.047$). Moreover, overall stress prevalence also shows a significant association with overall elevated blood pressure ($\chi^2 = 7.997$, $p = 0.003$). However, academic stress, peer pressure, and teacher interaction were not significantly associated with elevated blood pressure after adjusting for age group. These findings suggest that age acted as a cofounder for selected psychosocial stress factors.

Table 5
Stratified analysis of psychosocial stress and overall elevated blood pressure by age

Source and level of Psychosocial stress	Adolescents Age group	Normal BP n (%)	Elevated BP n (%)	Pearsons χ^2	Mantel Haenszel (weighted χ^2)	P-value
Home life stress						
Not stressful	8–9 years	43(82.7)	9(17.3)	3.396	7.488	0.005
Stressful	10–14 years	39(95.1)	2(4.9)	5.373		
Not stressful		95(70.4)	40(29.6)			
Stressful		89(83.2)	18(16.8)			
Social relation						
Not stressful	8–9 years	51(83.6)	10(16.4)	3.543	4.795	0.021
Stressful	10–14 years	31(96.9)	1(3.1)	2.918		
Not stressful		107(72.3)	41(27.7)			
Stressful		77(81.9)	17(18.1)			
Academic stress						
Not stressful	8–9 years	43(86.0)	7(14.0)	0.489	2.387	0.093
Stressful	10–14 years	39(90.7)	4(9.3)	2.353		
Not stressful		93(72.1)	36(27.9)			
stressful		91(80.5)	22(19.5)			
Peer pressure						
Not stressful	8–9 years	55(87.3)	8(12.7)	0.142	0.026	0.761
stressful	10–14 years	27(90.0)	3(10.0)	0.027		
Not stressful		112(75.7)	36(24.3)			
stressful		72(76.6)	22(23.4)			
Teacher interaction						
Not stressful	8–9 years	49(83.1)	10(16.9)	4.058	3.049	0.060
stressful	10–14 years	33(97.1)	1(2.9)	1.347		
Not stressful		95(73.1)	35(26.9)			
stressful		89(79.5)	23(20.5)			

Source and level of Psychosocial stress	Adolescents Age group	Normal BP n (%)	Elevated BP n (%)	Pearsons χ^2	Mantel Haenszel (weighted χ^2)	P-value
Home life stress						
Future uncertainty						
Not stressful	8–9 years	51(83.6)	10(16.4)	3.543	5.455	0.014
stressful	10–14 years	31(96.9)	1(3.1)	3.509		
Not stressful		98(71.5)	39(28.5)			
Stressful		86(81.9)	19(18.1)			
Financial hardship						
Not stressful	8–9 years	44(84.6)	8(15.4)	0.232	3.458	0.047
stressful	10–14 years	38(92.7)	3(7.3)	0.099		
Not stressful		85(71.4)	34(28.6)			
Stressful		99(80.5)	24(19.5)			
Overall stress						
Not stressful	8–9 years	40(81.6)	9(18.4)	4.247	7.997	0.003
stressful	10–14 years	42(95.5)	2(4.5)	5.365		
Not stressful		79(69.3)	35(30.7)			
Stressful		105(82.0)	23(18.0)			

Table 6 presents a stratified analysis to examine the association between psychosocial stress factors and overall elevated blood pressure while controlling for potential confounding by sex using the Mantel-Haenszel method. When stratified by sex, the Mantel-Haenszel analysis revealed that home life stress remained significantly associated with elevated blood pressure ($\chi^2 = 6.933$, $p = 0.007$). Social relation stress also shows a significant association with elevated blood pressure after adjusting for sex ($\chi^2 = 4.275$, $p = 0.029$). Furthermore, future uncertainty showed a statistically significant association with elevated blood pressure among males and females ($\chi^2 = 4.186$, $p = 0.030$). However, academic stress, peer pressure, teacher interaction, and financial stress did not reach statistical significance after adjusting for sex. Overall stress prevalence shows a significant association with overall elevated blood pressure ($\chi^2 = 6.902$, $p = 0.006$) while adjusting for sex.

Table 6
Stratified analysis of psychosocial stress factor and overall elevated blood by sex

Psychosocial stress factor	Gender	Normal BP n (%)	Elevated BP n (%)	Pearson's χ^2	Mantel - Haenszel (weighted χ^2)	p-value
Home life stress						
Not stressful	Male	57(74.0)	20(26.0)	0.759	6.933	0.007
Stressful	Female	38(80.9)	9(19.1)	8.205		
Not stressful		81(73.6)	29(26.4)			
Stressful		90(89.1)	11(10.9)			
Social relation						
Not stressful	Male	58(74.4)	20(25.6)	0.596	4.275	0.029
Stressful	Female	37(80.4)	9(19.6)	4.982		
Not stressful		100(76.3)	31(23.7)			
Stressful		71(88.8)	9(11.3)			
Academic stress						
Not stressful	Male	54(75.0)	18(25.0)	0.249	2.127	0.112
Stressful	Female	41(78.8)	11(21.2)	2.744		
Not stressful		82(76.6)	25(23.4)			
Stressful		89(85.6)	15(14.4)			
Peer pressure						
Not stressful	Male	65(75.6)	21(24.4)	0.167	0.008	0.957
Stressful	Female	30(78.9)	8(21.1)	0.062		
Not stressful		102(81.6)	23(18.4)			
Stressful		69(80.2)	17(19.8)			
Teacher interaction						
Not stressful	Male	55(74.3)	19(25.7)	0.536	2.159	0.109
Stressful	Female	40(80.0)	10(20.0)	2.193		
Not stressful		89(77.4)	26(22.6)			
Stressful		82(85.4)	14(14.4)			

Psychosocial stress factor	Gender	Normal BP n (%)	Elevated BP n (%)	Pearson's χ^2	Mantel - Haenszel (weighted χ^2)	p-value
Home life stress						
Future uncertainty						
Not stressful	Male	59(73.8)	21(26.3)	1.031	4.186	0.030
Stressful	Female	36(81.8)	8(18.2)	3.967		
Not stressful		90(76.3)	28(23.7)			
Stressful		81(87.1)	12(12.9)			
Financial stress						
Not stressful	Male	46(74.2)	16(25.8)	0.405	2.924	0.066
Stressful	Female	49(79.0)	13(21.0)	3.518		
Not stressful		83(76.1)	26(23.9)			
Stressful		88(86.3)	14(13.7)			
Overall stress						
Not stressful	Male	47(72.3)	18(27.7)	1.413	6.902	0.006
stressful	Female	48(81.4)	11(18.6)	6.831		
Not stressful		72(73.5)	26(26.5)			
stressful		99(87.6)	14(12.4)			

Discussion

Prevalence of psychosocial stress was high across multiple domains. Financial hardship was the most commonly reported stressor, affecting about half of the respondents, followed by academic stress and home life stress. Stress related to future uncertainty affected also affected few of the respondents, while social relations and teacher interaction affected majority of the respondents. Overall, more than half of the adolescents experienced psychosocial stress. This finding is consistent with a study conducted in India among medical students, where a prevalence of psychosocial stress was found to be 53%, slightly higher compared to the prevalence found in this study [21]. Similarly, Vaidya and Mulgaonkar in their study, reported a comparable prevalence of psychosocial stress among adolescents [22]. The high prevalence of psychosocial stress found in this study highlights the considerable psychosocial burden experienced by children and adolescents, particularly in the low-middle income settings where financial constraints, educational demands, and family related challenges are common.

Bivariate analysis further revealed significant associations between specific psychosocial stressors and blood pressure status. Financial hardship was significantly associated with elevated systolic blood pressure with a higher proportion of elevated SBP observed among adolescents who reported financial stress compared to those who did not. This finding suggests that chronic economic stress may influence systolic blood pressure through sustained activation of the body's stress-response systems. Persistent financial stress activates the sympathetic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis, resulting in increased secretion of catecholamines (epinephrine and norepinephrine) and cortisol. These stress hormones increase heart rate, cardiac output, and peripheral vascular resistance through vasoconstriction, leading to transient elevations in blood pressure. When stress becomes chronic, repeated activation of these neuroendocrine pathways contributes to sustained increases in systolic blood pressure. Chronic cortisol exposure may also promote sodium and water retention, enhance vascular sensitivity to catecholamines, and induce metabolic disturbances that further predispose individuals to hypertension.

Other stress domains, including social relationship stress and future uncertainty, demonstrated a probable relationship with elevated blood pressure, although the associations did not reach statistical significance. Nevertheless, these findings suggest that psychosocial challenges related to interpersonal relationships and uncertainty about the future may contribute to physiological stress responses. Chronic exposure to these may result in repeated sympathetic activation which may implicate the development of elevated blood pressure. The absence of statistical significance may reflect limited statistical power warranting further investigation in larger longitudinal studies.

Regarding diastolic blood pressure, home life stress showed a statistically significant association with elevated DBP. Adolescents experiencing home life stress had a higher proportion of elevated DBP compared to those without such stress. This finding underscores the importance of the family environment in shaping cardiovascular responses, as chronic domestic stress may lead to persistent autonomic imbalance and elevated diastolic pressure [23]. Furthermore, chronic home-related stress may negatively influence health behaviours such as sleep quality, physical activity, and dietary habits thereby further increasing the risk of elevated blood pressure.

Furthermore, the overall psychosocial stress was significantly associated with overall blood pressure status, with the chi-square analysis showing a significant relationship. This finding suggests that cumulative exposure to multiple stressors may be more influential than individual stress domains alone. This observation supports the concept of allostatic load, which proposes that repeated or prolonged activation of physiological stress-response systems results in cumulative biological wear and tear. Continuous activation of the sympathetic nervous system, Hypothalamus-pituitary-adrenal axis may progressively impair cardiovascular regulation, ultimately increasing the likelihood of elevated blood pressure. Psychosocial stress may also indirectly increase blood pressure through unhealthy lifestyle behaviours, including poor diet, physical inactivity, inadequate sleep, and obesity, all of which established risk factors for hypertension among children and adolescents [26]

The stratified Mantel-Haenszel analysis further indicated that selected psychosocial stress factors, particularly home life stress, social relationship and future uncertainty, remained significantly associated with elevated blood pressure after controlling for age group and sex. In contrast, academic stress, peer pressure, and teacher interaction did not demonstrate statistically significant associations after adjustment, indicating that their relationship with elevated blood pressure may be modified by other behavioural, environmental, or biological factors like body mass index, physical activity, dietary factors, family history of hypertension, and sleep patterns. These findings emphasize the complex and multifactorial pathways through which psychosocial stress influences cardiovascular health and highlight the importance of interventions aimed at reducing chronic psychosocial stress during adolescence to prevent the early development of hypertension and subsequent cardiovascular disease.

Conclusion

Psychosocial stress factor, particularly financial hardship and home life stress, was significantly associated with overall blood pressure at the bivariate level. Financial hardship and home life stress also shows a significant association with DBP and SBP respectively. In a stratified analysis, home life stress, social relationships, and future uncertainty were also significantly related to elevated blood pressure after controlling for age group and sex. The high prevalence of psychosocial stress and its observed relationship with blood pressure underscore the need for early cardiovascular screening and psychosocial interventions targeting adolescents, especially those in economically constrained or stressful family environments.

Limitations

The cross-sectional design of this study limits the causal relationship between psychosocial stress and elevated blood pressure. Psychosocial stress was assessed using self-reported measures, which may be affected by recall and social desirability bias. Blood pressure was measured at a single time point, potentially leading to miscalculation due to transient physiological or emotional influences, this might have increase or reduce the prevalence estimate and also affect the association with elevated blood pressure. Additionally, the findings are limited to children and adolescents within a specific geographical area, and also purposively selection of communities due to accessibility may introduce selection bias, restricting generalizability. The sample size may also have reduced statistical power to detect significant associations in multivariate analyses. Due to the selection of two eligible children per household, clustering effect at the household level may limit the outcome of the study. Furthermore, confounding variables such as physical activities, dietary patterns, Body mass index and sleep patterns were not accounted for, which may influence the outcome effect of psychosocial stress and elevated blood pressure.

Declarations

Ethical approval

This study formed part of the larger project titled “Development of An Automated System for Dynamic Prediction of High Blood Pressure in School Children and Adolescents”. Ethical approval for the umbrella study was obtained from the University of Ibadan/University College Hospital ethical review committee. The approval to conduct this study was issued on **06/10/2025** and remained valid till **05/10/2026**, and is documented in the ethics certificate number **UI/EC/25/0662**. The project's implementation ensured the confidentiality of participants and privacy during data collection. Voluntary informed consent was obtained from all respondents.

Consent to participate:

Before data collection, the study objectives, procedures, potential risks, and benefits were explained to the parents or legal guardians of eligible participants. Voluntary written parental/guardian informed consent was obtained for respondents below 12 years old, and for respondents 12 years and above, individual written assents were obtained before the start of the study.

Consent to publish:

Not Applicable.

Clinical trial number

Not Applicable

Conflict of Interest:

The authors declare no conflict of interest.

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Author Contribution

MDD, DOA, and AAA conceived and designed the study, contributed substantially to the development of the study methodology, coordinated data collection and management, performed the statistical analysis,

and interpreted the findings. MDD, DOA, and AAA also led the drafting and preparation of the manuscript. POO, JEW, DHA, AJS, and MAA contributed to data collection, data management, interpretation of findings, and critical revision of the manuscript for important intellectual content. ADA, KIA, TOA, BOA, and OFWO contributed to the interpretation of the results and critically reviewed and revised the manuscript for important intellectual content. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work were appropriately investigated and resolved.

Data Availability

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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