MEDWIN PUBLISHERS
Committed to Create Value for Researchers

Anthropology and Ethnology Open Access Journal
ISSN: 2639-2119

Blood Pressure in Relation to Age, Body Mass Index and Socioeconomic Status among the Khasi Women of Sohra (Cherrapunji) of Meghalaya, India

Hadem HH Baladiang and Khongsdier R*

Department of Anthropology, North-Eastern Hill University, India

***Corresponding author:** Khongsdier R, Department of Anthropology, North-Eastern Hill University, Shillong-7930 22, India, Email: rkhongsdier@hotmail.com

Research Article

Volume 5 Issue 2

Received Date: October 22, 2022

Published Date: November 23, 2022

DOI: 10.23880/aeoaj-16000187

Abstract

The present community study describes the nature of relationship between blood pressure and body mass index (BMI) in relation to sociodemographic factors among the Khasi mothers of Sohra (Cherrapunji), Meghalaya, India. It was found that older mothers were significantly heavier than younger mothers in terms of both body weight ($p < 0.01$) and BMI ($p < 0.01$), and the relation between age and BMI was positively significant ($p < 0.01$). The prevalence of underweight was about 15% and 12% among the younger and older mothers, respectively; whereas the prevalence of overweight exceeded that of underweight, and it was statistically higher ($p < 0.01$) in older mothers (34%) than in their younger counterparts (25%). The prevalence of hypotension was about 16% among mothers below 30 years old, which was significantly higher than among older mothers ($p < 0.001$). However, older mothers had a higher prevalence of prehypertension and hypertension compared to younger mothers ($p < 0.001$). The marginal effects of socioeconomic status on age-adjusted blood pressure in terms of household income and educational levels were not statistically significant. The regression analysis indicated a non-linear relationship between BMI and blood pressure. It was found that younger women had on average lower age-adjusted blood pressure than those with normal BMI. However, the effect of being underweight on age-adjusted blood pressure disappeared when overweight was included in the model, indicating that overweight women had on average higher age-adjusted blood pressure than underweight women in the present study. Therefore, it is likely that the positive correlation between BMI and blood pressure may predominantly be due to elevated blood pressure at higher BMI levels, especially in populations with decreasing proportion of underweight due to a rapid increase in overweight and obesity. Our findings may also have certain implications for the relation between underweight and other adverse health outcomes of undernutrition in less developed countries.

Abbreviations: BMI: Body Mass Index; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; SPSS: Statistical Package for the Social Sciences.

Introduction

It is a well-established fact that high blood pressure is a leading cause of cardiovascular diseases and deaths in more developed and less developed countries. According to the World Health Organization [1], about 1.28 billion adults aged 30-79 years worldwide have hypertension, and about two-thirds of them are living in low- and middle-income countries. Many studies have also indicated an increased risk of severe or fatal COVID-outcomes including mortality among patients with hypertension [2,3]. The prevalence of hypertension varies across regions and socioeconomic groups. In India, the prevalence of hypertension among adults aged 18 years and over increased from 22.9 percent in 2010 to 26 percent in 2017 especially in urban areas [4,5]. Of the modifiable factors, overweight and/or obesity are considered a major factor to elevated blood pressure [6-7]. Overweight and obesity, or excess accumulation of body fat, are defined as a body mass index (BMI) of more than 25 and 30 kg/m2, respectively [8,9]. Many studies have shown that overweight and obesity are also associated with diabetes, renal failure, cardiovascular diseases [10] and all-cause mortality [11-13]. Epidemiological studies in developed countries have shown that excess body weight gain is attributable to the development of hypertension, and the relationship between blood pressure and BMI is almost linear [6,14].

The basic mechanism of obesity-related hypertension is not fully understood, but it is likely that multiple pathogenetic mechanisms may contribute to the development of higher BP in obese individuals [6,15]. Moreover, obesity-related hypertension is nothing but a relation between high blood pressure and BMI, which is also used as indicator of underweight (BMI= < 18.5 kg/m) due to chronic energy deficiency or low body fat percentage [8]. Therefore, it is unclear whether the relation between blood pressure and BMI is linear or non-linear particularly in less developed countries like India where both underweight and overweight coexist. Moreover, BMI may also vary according to socioeconomic development or demographic transition [16-18]. Previous studies and reviews in Northeast India [4,5,19] have suggested that changes in dietary and physical activity patterns associated with urbanization are likely to predispose many individuals to being overweight, obese, diabetic, and hypertensive. In the present study, an attempt has been made to analyze our findings on blood pressure in relation to age, body mass index, and socioeconomic status among the Khasi women in the state of Meghalaya, India.

Materials and Methods

The present study was conducted among the Khasis of Sohra (Cherrapunjee) area in the East Khasi Hills district of Meghalaya, India. A cross-sectional sample of 705 non-pregnant mothers aged 15-50 years. An informed consent was obtained from each of the 705 participants before the commencement of the study. Anthropometric measurements, such as height and weight were taken following standard techniques [20]. Body mass index (BMI)= weight (in kilograms)/height (in square meters) was used to assess the nutritional status, and BMI categories were classified as < 18.5 kg/m^2, 18.5 to 22.9 kg/m^2, and ≥ 23 kg/m^2 as underweight, normal weight, and overweight/or obese [21].

Data on socioeconomic and demographic status were based on education level and on per capita monthly income of households collected directly from each participant, using appropriate schedules. The socioeconomic status was based on percentile distribution of per capita monthly income as follows: Above 75th percentile (> Rs 2778) = High Income Group 50th to 75th percentile (Rs 2000 - Rs 2778) = Middle Income Group Below 50th percentile (< Rs 2000) = Low Income Group. Blood pressure was recorded, using a standard mercury sphygmomanometer and a stethoscope by taking the mean of three readings that were taken five minutes apart [22]. Systolic blood pressure (SBP) was recorded as the first Korotkoff sound, and diastolic blood pressure (DBP) was recorded when the Korotkoff sound disappeared [23]. All measurements were taken on the left hand of the participant. Each participant was asked to relax and take rest for about 10 minutes before taking the measurement. Untreated blood pressure values of SBP 120-139 mm Hg and/or DBP 80-89 mm Hg were classified as pre-hypertension, whereas hypertension was defined as SBP ≥ 140 mmHg and/or DBP ≥ 90 mm Hg [24]. Mothers with SBP of < 90 mm Hg or DBP of < 60 mm Hg were considered as hypotensive.

Data were managed and analyzed using Statistical Package for the Social Sciences (SPSS, version 26) software with a level of significance at five percent. The results were presented into two broad age groups, namely younger mothers (< 30 years) and older mothers (≥ 30 years). Descriptive statistics were generated in terms of sample size, percentage, mean, and standard deviation. Student t-test was used to test the differences between two means. Categorical variables like hypertension, nutritional status, and socioeconomic status were summarized by count and percentages. Chi-square (χ^2) test was used to test if there was any relationship between hypertension and other independent variables. Karl Pearson's coefficient of correlation (r) was used to test the linear relationship between two continuous variables. Stepwise-multiple regression analysis was carried out for testing the strength of association between age- adjusted systolic blood pressure and other independent variables like anthropometric, nutritional, and socioeconomic status.

Results

Table 1 gives the means and standard deviations of the anthropometric measurements and blood pressure for the younger and older mothers aged < 30 and ≥ 30 years, respectively. The older mothers were significantly heavier than younger mothers in body weight ($t = 2.53$, $p < 0.01$) and BMI ($t = 2.90$, $p < 0.01$), and the relation between age and BMI was positively significant ($r = 0.131$, $p < 0.01$). There were also significant differences between older and younger mothers in respect of both systolic blood pressure ($t = 3.30$, $p < 0.001$) and diastolic blood pressure ($t = 5.36$, $p < 0.0001$).

The relation between age and blood pressure was positively significant for both systolic blood pressure ($r = 0.175$, $p < 0.01$) and diastolic blood pressure ($r = 0.236$, $p < 0.01$), suggesting that blood pressure increased with advancing age.

Characteristics	< 30 years (n = 296		≥ 30 years (N= 409		t-value (2-tailed)
	Mean	SD	Mean	SD	
Weight (kg)	44.23	7.78	45.76	8	2.53*
Height (cm)	143.64	5.57	143.57	5.07	0.17
BMI (kg/m2)	21.39	3.28	22.15	3.37	2.90*
Systolic blood pressure (mmHg)	109.91	12.93	113.54	16.14	3.30**
Diastolic blood pressure (mmHg)	68.7	11.18	73.49	12.05	5.36**

*p < 0.01; **p < 0.001.

Table 1: Anthropometric measurements and blood pressure.

When classificatory categories of BMI and blood pressure are used as indicators of the nutritional status and hypertension, Table 2 shows that about 13% and 30% of women were underweight and overweight, respectively. It was also observed that the prevalence of underweight was higher among younger mothers (15%) than among older mothers (12%), although it was not statistically significant ($\chi^2 = 1.74$, d.f. = 1, $p > 0.05$). Similarly, the prevalence of overweight and/or obesity was statistically higher ($\chi^2 = 6.75$, $p < 0.01$) in older mothers (34%) compared to their younger counterparts (25%). The prevalence of hypotension, prehypertension, and hypertension were 12%, 23%, and 9%, respectively, for mothers of all groups. The prevalence of hypotension was about 16% among mothers below 30 years of age, which was significantly higher compared to their older counterparts ($\chi^2 = 13.74$, d.f. = 1, $p < 0.001$). However, older mothers had a higher prevalence of prehypertension and hypertension than younger mothers ($\chi^2 = 12.85$, d.f. = 1, $p < 0.001$). Table 2 also shows that the prevalence of hypertension (11%) among mothers aged 30 years and over was higher than among younger mothers (5%). The underweight and hypotension prevalence was higher in younger mothers than in older mothers. In contrast, the prevalence of overweight and elevated blood pressure was higher in mothers aged 30 years and older.

Characteristics	<30 years (N =296)		≥ 30 years (N =409)		Total (N = 705)	
	Number	%	Number	%	Number	%
Nutritional status						
Normal	179	60.47	224	54.77	403	57.16
Underweight	44	14.86	47	11.49	91	12.91
Overweight	73	24.66	138	33.74	211	29.93
BP classification						
Hypotensive	50	16.89	32	7.82	82	11.63
Normotensive	175	59.12	227	55.5	402	57.02
Prehypertensive	56	18.92	104	25.43	160	22.7
Hypertensive	15	5.07	46	11.25	61	8.65
Income level						
Low	113	38.18	227	55.5	340	48.23
Middle	105	35.47	89	21.76	194	27.52
High	78	26.35	93	22.74	171	24.26
Educational level						
Primary	127	42.91	229	55.99	356	50.5
Secondary	71	23.99	82	20.05	153	21.7
≥ Higher Secondary	98	33.11	98	23.96	196	27.8

Table 2: Blood pressure, nutritional, and socioeconomic status by age groups.

Table 2 further shows that about 48% of the women included in this study belonged to the low income group. The proportion of women in the low-income group was significantly higher in the older age groups compared to the younger age groups ($\chi^2 = 20.64$, d.f. = 1, $p < 0.001$). Similarly, the proportion of women with primary level of education was significantly lower in the younger age group compared to the higher age groups ($\chi^2 = 11.76$, d.f. = 1, $p < 0.001$).

Table 3 shows the results of the regression analysis of age-adjusted SBP in relation to anthropometric, nutritional, and socioeconomic factors. The marginal effects of socioeconomic status in terms of household income and educational levels were not statistically significant after adjusted for age. Adjusted for age, about 11% ($R^2 = 0.110$) and 10% ($R^2 = 0.10$) of the variation in SBP was due to body weight and BMI, respectively. The regression slope was, however, negatively significant ($\beta = -5.175 \pm 1.650$, t = 3.14, $p < 0.002$), indicating that younger women had, on average, about 5.18 mm Hg lower age- adjusted SBP than those with normal BMI. However, when overweight was included in the model as binary variable relative to normal BMI, the negative association between underweight and low SBP was no longer significant ($\beta = -3.060 \pm 1.673$, t = 1.82, $p > 0.05$). In other words, the effect of being underweight on age-adjusted SBP disappeared when overweight was included in the model, indicating that overweight women had, on average, about 6.31 mm Hg higher age-adjusted SBP than underweight women in the present study ($\beta = 6.31 \pm 1.123$, t = 5.12, $p > 0.0001$).

Systolic blood pressure				
Characteristics	**R square**	**β (standard error)**	**t-value**	**p-value**
Weight (kg)	0.11	0.536 (0.068)	7.92	0.0001
Height (cm)	0.046	0.351 (0.104)	3.36	0.001
BMI (kg/m2)	0.1	1.189 (0.161)	7.38	0.0001
Nutritional status	0.078			
Normal	-	-	-	-
Underweight vs. Normal[1]	0.044	-5.175 (1.650)	3.14	0.002
Underweight vs. Normal[2]	-	-3.060 (1.673)	1.83	0.068
Overweight vs. Normal[3]	-	6.307 (1.233)	5.12	0.0001
Income level	0.035			
Low	-	-	-	-
Middle vs. Low	-	2.174 (1.338)	1.62	0.105
High vs. Low	-	1.882 (1.384)	1.32	0.188
Educational level	0.031			
Primary	-	-		
Secondary vs. Primary	-	0.974 (1.439)	0.68	0.499
≥ Higher Secondary vs. Primary	-	0.852 (1.334)	0.64	0.523

1-Underweight adjusted for age; 2-Underweight adjusted for age and overweight and/or obesity; 3- Overweight adjusted for age.

Table 3: Regression analysis of age-adjusted systolic blood pressure in relation to anthropometric, nutritional, and socioeconomic variables.

Table 4 shows the similar results of the regression analysis of age-adjusted DBP to those carried out for age-adjusted SBP. The marginal effects of both household income and educational levels were not significantly associated with age-adjusted DBP. About 12.3% ($R^2 = 0.123$) and 11.8% ($R^2 = 0.118$) of the variation in DBP was attributed to body weight and BMI, respectively. The Table shows that the regression slope for the age-adjusted DBP was inversely significant with underweight ($\beta = -3.237 \pm 1.298$, t = 2.49, $p < 0.013$), suggesting that underweight women had lower age-adjusted DBP than women with normal BMI. Similar to age-adjusted SBP, the significant association between underweight and low DBP disappeared when overweight was included in the model ($\beta = -1.589 \pm 1.316$, t = 1.21, $p > 0.05$). On the other hand, the results show that the age-adjusted DBP was positively associated with overweight ($\beta = 4.916 \pm 0.970$, t = 5.07, $p < 0.0001$), indicating that overweight mothers had, on average, about 4.92 mm Hg higher DBP than mothers with normal BMI.

Diastolic Blood Pressure				
Characteristics	**R square**	**β (standard error)**	**t-value**	**p-value**
Weight (kg)	0.123	0. 391 (0.053)	7.34	0.0001
Height (cm)	0.065	0.211 (0.082)	2.57	0.01
BMI (kg/m^2)	0.118	0.897 (0.127)	7.07	0.0001
Nutritional status	0.097			
Normal	-	-	-	-
Underweight vs. Normal[1]	0.064	-3.237 (1.298)	2.49	0.013
Underweight vs. Normal[2]	-	-1.589 (1.316)	1.21	0.228
Overweight vs. Normal[3]	-	4.916 (0.970)	5.07	0.0001
Income level	0.057			
Low	-	-	-	-
Middle vs. Low	-	1.105 (1.051)	1.05	0.293
High vs. Low	-	0.068 (1.087)	0.06	0.95
Educational level	0.031			
Primary	-	-		
Secondary vs. Primary	-	1.633 (1.127)	1.45	0.148
≥ Higher Secondary vs. Primary	-	1.183 (1.045	1.13	0.258

1-Underweight adjusted for age; 2-Underweight adjusted for age and overweight and/or obesity; 3- Overweight adjusted for age.

Table 4: Regression analysis of age-adjusted diastolic blood pressure in relation to anthropometric, nutritional, and socioeconomic variables.

Discussion

The present findings indicate that older mothers were significantly heavier than their younger counterparts in respect of body weight and BMI. It was found that the prevalence of underweight was higher among younger mothers than among older mothers, although it was not statistically significant. Similarly, the prevalence of overweight and/or obesity was statistically significant higher in older mothers compared to younger mothers. There were also significant differences between older and younger mothers in respect of DBP and DBP, and both SBP and DBP increased with advancing age. Overall, the present findings are consistent with those earlier studies and reviews, suggesting that blood pressure increases with increasing age and BMI [6,14,25-26].

However, the present findings may be interpreted with caution. Recent studies of South Asian populations have shown that BMI was not much associated with vascular mortality [27], although elevated BMI is associated with increased systolic blood pressure [28,29], despite some inconsistencies [30]. The relationship between BMI and morbidity and/or mortality has been shown to be non-linear even those reported from developed countries [31,32]. Depending upon the type of statistical analysis used in a given study, different interpretations can be made from a given dataset on the relation between BMI and morbidity or mortality [33]. BMI is a crude measure of overweight and obesity, and it is also an indicator of underweight-related morbidity and mortality, which is in turn related to ethnicity and socioeconomic factors within and across populations [8,34]. An excess accumulation of body fatness also varies between ethnic and socioeconomic groups, and many studies have supported that the cut-offs are too high for South Asian populations which have a greater risk of cardiovascular and metabolic diseases even at a lower level of BMI [17,21,35,36].

The present study also indicates that the prevalence of underweight as well as hypotension was higher in younger mothers than in older mothers, whereas the prevalence of overweight with elevated blood pressure was higher among mothers aged 30 years and older. The stepwise multiple regression analysis on age-adjusted SBP and DBP suggests that younger women had, on average, lower blood and hypotension than those with normal BMI. However, the marginal effects of being underweight on blood pressure disappeared when overweight was included in the model, suggesting that overweight mothers had, on average, higher blood pressure than mothers with normal BMI. Therefore, it is likely that age- adjusted blood pressure may not be positively correlated with BMI below the normal level. Subject to further studies with larger sample sizes, the present study indicates that underweight mothers had higher prevalence of hypotension than those with normal BMI. It is likely that the positive correlation between BMI and blood pressure may predominantly be due to elevated blood pressure at higher BMI levels, especially in populations with decreasing proportion of underweight due to a rapid increase in overweight and obesity. Our findings may also have certain implications for the relation between underweight and other morbidities including infections, anemia, osteoporosis, sarcopenia, anorexia nervosa, strokes, myocardial infarction, health quality of life, disabilities, and other adverse health outcomes of undernutrition [37,38].

Our findings are also consistent with some other studies from less developed countries where hypertension is associated with overweight and/or obesity, whereas hypotension or low blood pressure is correlated with underweight [39,40], thereby indicating that blood pressure does not increase at all levels of BMI as observed among some tribal populations in India [41]. Further, the marginal effects of both household income and educational levels were not significantly associated with age-adjusted blood pressure, suggesting that other lifestyles and dietary factors may be associated with elevated BMI and blood pressure [19,42-44].

Conclusion

The present findings indicate that older mothers had higher BMI and blood pressure. The prevalence of underweight as well as hypotension is higher in younger mothers than in older mothers. On the contrary, the prevalence of overweight, along with elevated blood pressure, was higher in older mothers aged 30 years and over. The marginal effects of both household income and educational levels were not significantly associated with age-adjusted blood pressure, suggesting that other lifestyles and dietary factors may be associated with elevated BMI and blood pressure. The age-adjusted SBP and DBP indicated that younger women had, on average, lower blood pressure and hypotension than those with normal BMI. However, the marginal effects of underweight on blood pressure disappeared when overweight was included in the model, suggesting that the effect of underweight on blood pressure was suppressed by the greater effect of overweight and obesity. This finding may have certain implications for populations in less developed countries with higher mean values of BMI due to change in life-styles associated with increasing urbanization and socioeconomic development.

References

1. WHO (2021) Hypertension.
2. Pranata R, Lim MA, Huang I, Raharjo SB, Lukito AA, et al. (2020) Hypertension is associated with increased mortality and severity of disease in COVID-19 pneumonia: A systematic review, meta-analysis and meta-regression. J Renin Angiotensin Aldosterone Syst 21(2): 1470320320926899.
3. Du Y, Zhou N, Zha W, Lv Y (2021) Hypertension is a clinically important risk factor for critical illness and mortality in COVID-19: A meta-analysis. Nutr Metab Cardiovasc Dis 31(3): 745-755.
4. Lalnuneng A, Khongsdier R (2017) Rural-urban differences in hypertension among the Hmars of Manipur in Northeast India. Anthropologist 28(3): 173-183.
5. Lalnuneng A (2021) Age variation in blood pressure: Rural–urban and sex differences among the Hmar adults of Manipur, Northeast India. Am J Hum Biol 34(3): 23656.
6. Van Gaal LF, Mertens IL, De Block CE (2006) Mechanisms linking obesity with cardiovascular disease. Nature 444(7121): 875-880.
7. Tuan NT, Adair LS, Suchindran CM, He K, Popkin BM, et al. (2009) The association between body mass index and hypertension is different between East and Southeast Asians. American Journal of Clinical Nutrition 89(6): 1905-1912.
8. WHO (1995) Physical Status: The Use and Interpretation of Anthropometry, Report of a WHO Expert Consultation.
9. WHO (2000) Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation.
10. Rahmouni K, Correia MLG, Haynes WG, Mark AL (2004) Obesity-associated hypertension: New insights into mechanisms. Hypertension 45(1): 9-14.
11. Flegal KM, Kit BK, Orpana H, Graubard BI (2013) Association of all-cause mortality with overweight and obesity using standard body mass index categories: A systematic review and meta-analysis. JAMA 309(1): 71-82.
12. Rojas NBA, Lacey B, Soni M, Charles S, Carter J, et al. (2021) Body-mass index, blood pressure, diabetes and cardiovascular mortality in Cuba: Prospective study of 146,556 participants. BMC Public Health 21(1): 963.
13. The Global BMI Mortality Collaboration (2016) Body-mass index and all-cause mortality: Individual

participant-data meta-analysis of 239 prospective studies in four continents. Lancet 388(10046): 776-86.

14. Gelber RP, Gaziano JM, Manson JE, Buring JE, Sesso HD, et al. (2007) A prospective study of body mass index and the risk of developing hypertension in men. Am J Hypertens 20(4): 370-377.
15. Ersoy C, Ersoy A (2019) Obesity and Hypertension. Turk J Int Med 1(1): 6-14.
16. Dressler WW, Bindon JR (2000) The health consequences of cultural consonance: Cultural dimensions of lifestyle, social support, and arterial blood pressure in an African American community. American Anthropologist 102(2): 244-260.
17. WHO Expert Consultation (2004) Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 363(9403): 157-163.
18. Popkin BM (2017) Relationship between shifts in food system dynamics and acceleration of the global nutrition transition. Nutrition Review 75(2): 73-82.
19. Khongsdier R (2008) Increasing urbanisation in tribal states of Northeast India: Implications for the prevalence of chronic diseases. Tribes Tribals 2: 25-33.
20. Lohman TG, Roche AF, Martorell R (1988) Anthropometric Standardization Reference Manual. Human Kinetics Books, Champaign, IL, USA, pp: 1-177.
21. WHO (2000) The Asia Pacific perspective: Redefining Obesity and Its Treatment.
22. Beevers G, Lip GHY, O'Brien E (2001) Blood pressure measurement. BMJ 322: 1043-1047.
23. Sherwood L, Ward C (2019) Human Physiology: From Cells to Systems 4th (Edn) Nelson Education Ltd, Toronto, Canada, pp: 1-778.
24. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, et al. (2003) The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: The JNC 7 report. JAMA 289(19): 2560-2572.
25. Caleyachetty R, Thomas GN, Toulis KA, Mohammed N, Gokhale KM, et al. (2017) Metabolically healthy obese and incident cardiovascular disease events among 3.5 million men and women. J Am Coll Cardiol 70(12): 1429-1437.
26. Choi S, Kim K, Kim SM, Lee G, Jeong SM, et al. (2018) Association of obesity or weight change with coronary heart disease among young adults in South Korea. JAMA Intern Med 178(8): 1060-1068.
27. Gajalakshmi V, Lacey B, Kanimozhi V, Sherliker P, Peto R, et al. (2018) Body-mass index, blood pressure, and cause-specific mortality in India: A prospective cohort study of 500 810 adults. Lancet Glob Health 6(7): 787-794.
28. Hossain FB, Adhikary G, Chowdhury AB, Shawon MSR (2019) Association between body mass index (BMI) and hypertension in south Asian population: Evidence from nationally representative surveys. Clinical Hypertension 25: 28.
29. Sadiq A, Ghafoor A, Rehman FU, Akhter N, Hussain R, et al. (2022) Cross sectional comparative relationship of obesity with ischemic heart disease and its impacts: A clinical study. Pakistan Journal of Medical & Health Sciences 16(5): 1168-1170.
30. Thapa B, Deepti KC, Shrestha K, Gurung S (2022) Association between body mass index and blood pressure among adults. Journal of Gandaki Medical College-Nepal 15(1): 59-62.
31. Afzal S, Tybjaerg Hansen A, Jensen GB, Nordestgaard BG (2016) Change in body mass index associated with lowest mortality in Denmark, 1976-2013. JAMA 315(18): 1989-1996.
32. Zaccardi F, Dhalwani NN, Papamargaritis D, Webb DR, Murphy GJ, et al. (2017) Nonlinear association of BMI with all-cause and cardiovascular mortality in type 2 diabetes mellitus: A systematic review and meta-analysis of 414,587 participants in prospective studies. Diabetologia 60(2): 240-248.
33. Dumesnil JG, Pibarot P (2013) The obesity paradox in aortic stenosis. Journal of the American College of Cardiology 62(18): 1691-1693.
34. Rogge BP, Cramariuc D, Lønnebakken MT, Christa GB, John BC, et al. (2013) Effect of overweight and obesity on cardiovascular events in asymptomatic aortic stenosis: A SEAS sub-study (Simvastatin Ezetimibe in Aortic Stenosis). J Am Coll Cardiol 62(18): 1683-1690.
35. Popkin BM (2001) The nutrition transition and obesity in the developing world. J Nutr 131(3): 871S-873S.
36. Yap MD, Chew SK, Deurenberg P (2002) Elevated body fat percentage and cardiovascular risks at low body mass index levels among Singaporean Chinese, Malays and Indians. Obes Rev 3(3): 209-215.

37. Misra A, Khurana L (2011) Obesity-related non-communicable diseases: South Asians vs White Caucasians. International Journal of Obesity 35(2): 167-187.

38. Lee DH, Kim SY, Park JE, Jeon HJ, Park JH, et al. (2017) Nationwide trends in prevalence of underweight, overweight, and obesity among people with disabilities in South Korea from 2008 to 2017. Int J Obes (Lond) 46(3): 613-622.

39. Mungreiphy NK, Kapoor S, Sinha R (2011) Association between BMI, blood pressure, and age: Study among Tangkhul Naga tribal males of Northeast India. Journal of Anthropology 2011: 748147.

40. Afolabi IS, Chinedu SN, Iweala EEJ, Ogunlana OO, Azuh DE, et al. (2015) Body mass index and blood pressure in a semi-urban community in Ota, Nigeria. Food and Public Health 5(5): 157-163.

41. Kshatriya GK, Acharya SK (2019) Prevalence and risks of hypertension among Indian tribes and its status among the lean and underweight individuals. Diabetes & Metabolic Syndrome: Clinical Research & Reviews 13(2): 1105-1115.

42. Beilin LJ, Puddey IB, Burke V (1999) Lifestyle and hypertension. American Journal of Hypertension 12(9): 934-945.

43. Mayén AL, Vidal PM, Paccaud F, Bovet P, Stringhini S, et al. (2014) Socioeconomic determinants of dietary patterns in low- and middle-income countries: A systematic review. Am J Clin Nutr 100(6): 1520-1531.

44. Heath L, Jebb SA, Aveyard P, Piernas C (2022) Obesity, metabolic risk and adherence to healthy lifestyle behaviours: Prospective cohort study in the UK Biobank. BMC Medicine 20: 65.