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A CROSS-SECTIONAL STUDY ON BLOOD PRESSURE AND OBESITY AMONG RURAL ADULTS OF PASCHIM MEDINIPUR, WEST BENGAL, INDIA

Background. *Obesity is considered a major health problem in both developed and developing countries. Both hypertension and obesity are accountable for the increased risk of all-cause and cardiovascular mortality, and often they occur together. The objective of the present study was to know the prevalence of overall obesity (BMI≥25.0) and hypertension among rural adults. The present study determined the age trend on obesity and hypertension among rural adults of Daspur I block, Paschim Medinipur.*

Materials and methods. *A community based cross-sectional study was conducted among 805 rural adults (Males=396; Females=409) of Daspur I block, Paschim Medinipur district, West Bengal, from August to December 2019.*

Results. *In the present study, the total prevalence of overall obesity was 22.4% (19.7% in males and 24.9% in females) and hypertension was 36.8% (32.8% in males and 40.6% in females). The prevalence of both obesity and hypertension was much higher in case of female participants. Obesity was more among middle aged males and females. There was a significant association between obesity and blood pressure.*

Conclusion. *Our study revealed a high prevalence of obesity and hypertension among rural adults. In overall, the risk of obesity and hypertension was greater in females. There was a significant association between age and being obese and hypertensive.*

Keywords: Obesity; Blood pressure; Hypertension; Rural Adults; Age Group; India

Introduction

Hypertension is a demonstrated risk factor that leads to myocardial infarction, ischemic heart disease, stroke, renal failure, and death [Kearney, 2005; James, 2014]. Obesity increases the risk of morbidity from hypertension, dyslipidaemia, coronary heart disease (CHD), diabetes, stroke and heart failure [Corrigan et al., 1991; Peeters, 2003; Jensen, 2014; Alagiakrishnan, 2016]. Both hypertension and obesity are accountable for the increased risk of all-cause and cardiovascular mortality [Lewington, 2002; Whitlock, 2009; Berrington, 2010], and often they occur together [Jordan, 2012]. In many developing countries, socio-economic and demographic transitions have contributed to the burden of hypertension and obesity on individuals, society, and the economy [Kearney, 2005; Kotchen, 2010], and the transition of morbidity from communicable diseases to non-communicable diseases [Boutayeb, 2006; Lopez, 2006]. With urbanization and industrialization, the standard of living continues to improve particularly in developing countries. This has resulted in weight gain and obesity, which jeopardizes the health of citizens. In developing countries, both among adults and children obesity is perhaps the most prevalent form of malnutrition. Studies have demonstrated that obesity is associated with systolic blood pressure (SBP) and diastolic blood pressure (DBP) elevation, dyslipidaemia, diabetes, and many other diseases [Freedman, Perry, 2000; Sorof, Daniels, 2002; Yusuf et al., 2005]. The consequences of obesity and its burden on health is expected to reach epidemic proportions in developing countries like India [Srikanth, 2011]. There have been reports of an increase in the dimension of this problem in the high socio-economic group in India. The relationship between body mass index (BMI)(kg/m^2) and blood pressure has long been the subject of epidemiological research. There were also reports that indicate positive association of BMI (kg/m^2) and blood pressure among Asian populations. Rapid economic development and modernization with changing life style factors in India has an increasing trend of hypertension especially among urban population [Srikanth, 2011]. There was a stronger relationship between hypertension and general obesity as compared to the relationship between hypertension and either overweight or central obesity among both sexes [Wang et al., 2014].

The relevance of both obesity and hypertension, as major public health challenges, is increasing worldwide. In comparison with the year 2000, the number of adults with hypertension is predicted to increase by ~60% to a total of 1,56 billion by the year 2025 [Kearney, 2005]. Worldwide excess body weight is the sixth most important risk factor contributing to the overall burden of the disease [Haslam, James, 2005]. More than 1 billion adults and 10% of children are now classified as overweight or obese [Haslam, James, 2005].

In India the prevalence of overweight and obesity is alarmingly growing faster than the global average (years). For instance, the prevalence of overweight increased significantly among females from 8.4% to 15.5% between 1998 and 2015, and the prevalence of obesity increased from 2.2% to 5.1% over the same time period [Luhar et al., 2020; NFHS-2, 2000; NFHS-3, 2007; NFHS-4, 2007]. Despite the above figures, in India only a few studies have attempted to estimate future trends in overweight and obesity. One study that reports on global trends estimated that by 2030, 27.8% of all Indians would be overweight, and 5.0% obese [Kelly et al., 2008; Luhar et al., 2020]. Another study estimated that in rural India around 20.0% adults will be either overweight or obese by 2030 [Swain, Chowdhury, 2018; Luhar et al., 2020].

Presently, obesity and hypertension are a major health problem throughout the world. Although there are many studies that have discussed obesity and blood pressure in urban settings, however only a few studies have been conducted in rural settings about this dreaded condition. In India, numerous studies have been conducted on the prevalence of hypertension and obesity, but there is a need for more information about the topic. There are no documented studies related to obesity and hypertension in this block. Hence the present study is an endeavour to understand the obesity and hypertension situation of rural adults of Daspur I block, Paschim Medinipur district, West Bengal, India. This study aimed to investigate the prevalence of obesity and hypertension and their association with age (years) among the rural adults of Daspur I block, Paschim Medinipur district, West Bengal, India.

Materials and methods

A random sample of 805 rural individuals (aged above 18 years) were included in this cross-sectional study. This cross- sectional study was conducted among rural adults of Daspur I block, Paschim Medinipur district, West Bengal, India from the period of August to December, 2019.Data were collected from 4 villages (Rajnagar, Gokulnagar, Jadupur, Ramdebpur) under Daspur I block of Paschim Medinipur district, West Bengal, India. Data were collected by house-to-house survey and a semi-structured pretested questionnaire was used in this study. The participants were free from any physical deformities. Age (years) of the participants was recorded from Government issued identity proofs.

All anthropometric measurements were taken by the first author using standard procedures [Lohman et al., 1988]. After obtaining informed oral consent from all participants the height (cm), weight (kg) and the blood pressure (mmHg) of the subjects were measured. Height (cm) was measured using Martin's anthropometric rod to the nearest 0.10 cm. The participants were asked to stand erect without shoes, heels joined together, and eyes directed forward. Weight (kg) was measured with a portable weighing machine that was kept on a firm horizontal flat surface. Measurement of height (cm) and weight (kg) were taken with participants wearing light cloth without shoes and weight was recorded to the nearest 0.5 kg.

The blood pressure of the studied participants was measured using OMRON [Digital Automatic Blood Pressure Monitor]. The blood pressure in the left arm was measured after resting for at least five minutes. The blood pressure was taken in the sitting position, legs uncrossed, with the arm resting on a table and the ante-cubital fossa at the level of the lower sternum. Three blood pressure readings were measured to the nearest mmHg three minutes apart. The average of the two measurements was recorded.

The frequency of hypertension was determined using the JNC VII classification of blood pressure (table 1).

Intra-observer and inter-observer technical errors of the measurements (TEM) were calculated to determine the accuracy of the measurements using the standard procedure [Ulijaszek, Kerr, 1999]. To calculate TEM, a total of 50 adults, other than those covered in the present study were measured by the first author. The TEM was calculated using the following standard equation: $TEM = \sqrt{(\Sigma D^2/2N)}$, (D= Difference between the measurements, N= Number of individuals). The coefficient of reliability (R) was calculated from TEM using the following standard equation: $R = \{1-(TEM)^2/SD^2\}$ (SD= Standard deviation of the measurements).

Table 1. The frequency of hypertension was determined using the JNC VII classification of blood pressure
Таблица 1. Критерии, использованные для определения категорий артериального давления

Category	SBP (mmHg)	DBP (mmHg)
Normal	<120	<80
Prehypertension	120–139	80-90
Hypertension	≥140	≥90

The intra-observer and inter-observer TEM values were observed to be within the cut-off value (R=0.95) as recommended [Ulijaszek, Kerr, 1999]. Hence, the measurements recorded in the present study were being reliable and reproducible.

Body Mass Index (BMI) was calculated by using the below formula:

weight [kg]/ height^2[m].

Standard cut-off value of BMI based obesity for both sexes was determined higher than 25.00 kg/m^2 according to WHO standards (2000).

Chi-square (χ^2) was performed to test for sex differences in the prevalence of BMI based obesity and blood pressure; Chi-square (χ^2) analysis was performed to find out the association of obesity and hypertension with age (years)and the relationship between obesity and hypertension among both sexes. Age groups were prepared using percentiles (25th, 50th and 75th). The total population was classified into 4 age groups: lower age group: ≤ 30 years, middle age group: 31-42 years, 43-54 years and upper age group: ≥ 55 years. A p-value of 0.05 was considered to be statistically significant. All the statistical analyses were conducted in SPSS version 16.0.

Results

Table 2 presents the prevalence of blood pressure among studied participants. The prevalence of normal blood pressure (42.7% vs. 40.8%) and pre-hypertension (24.5% vs. 18.6%) was higher among males than females but the prevalence of hypertension was higher among females (40.6% vs. 32.8%) participants. Overall prevalence of hypertension was 36.8% among studied participants. There was a significant ($p<0.05$) sex difference on blood pressure among studied participants.

Table 3 presents the prevalence of obesity among studied participants. It was determined that the prevalence of obesity (24.9% vs. 19.7%) was more among female participants and males (80.3% vs. 75.1%) were more non-obese. There was a significant difference ($p<0.05$) between sex and obesity among studied participants.

Table 4 illustrates the age group wise prevalence of blood pressure and obesity. Among both sexes, the prevalence of normal blood pressure was higher among young individuals, and normal blood pressure decreases with increasing age (years). It was also observed that pre-hypertension is higher among young and middle age groups. Males were more prone to pre-hypertension than females. With increasing age (years), the prevalence of hypertension also increased among both males and females. The prevalence of hypertension among females was higher than males. The association between blood pressure and age groups was highly significant among males and females ($p<0.001$).

Table 3. Prevalence of obesity among studied participants
Таблица 3. Распространение ожирения в изученной группе

Sex	Non-obese	Obese	Total	χ^2
Male	318 (80.3)	78 (19.7)	396 (100.0)	3.184*
Female	307 (75.1)	102 (24.9)	409 (100.0)	
Total	625 (77.6)	180 (22.4)	805 (100.0)	

Notes. Percentages are presented in the parentheses; Statistically significant at * – $p< 0.05$.
Примечание. Проценты представлены в скобках, уровень значимости различий * – $p< 0.05$.

The prevalence of non-obese individuals was highest among younger age groups and older age groups. Obesity was most prevalent among middle aged individuals. There was a significant association between obesity and age groups among both males ($p<0.05$) and females ($p<0.001$).

Association between obesity and blood pressure among studied participants is presented in Table 5. This table indicated that the prevalence of obesity was much higher in case of hypertensive individuals, and it increased from normal stage to hypertension stage in both sexes. It was observed that the prevalence of obesity was higher in case of hypertensive females than in case of hypertensive males (30.1% vs. 26.9%). In addition to that, obesity had a significant ($p<0.05$) association with blood pressure among males and females.

Table 2. Prevalence of blood pressure among studied participants
Таблица 2. Частота распространения выделенных категорий артериального давления в изученной группе

Sex	Normal	Pre-hypertension	Hypertension	Total	χ^2
Male	169 (42.7)	97 (24.5)	130 (32.8)	396 (100.0)	6.731*
Female	167 (40.8)	76 (18.6)	166 (40.6)	409 (100.0)	
Total	336 (41.7)	173 (21.5)	296 (36.8)	805 (100.0)	

Notes. Percentages are presented in the parentheses; Statistically significant at * – $p< 0.05$.
Примечание. Проценты представлены в скобках, уровень значимости различий * – $p< 0.05$.

Table 4. Age group wise prevalence of hypertension and obesity among studied participants
Таблица 4. Частота встречаемости гипертонии и ожирения в различных возрастных группах

Variables	Sex	Age group (years)					χ^2	
Blood pressure (mmHg)		≤30	31-42	43-54	≥55	Total	M	F
Normal	M	71 (62.8)	42 (49.4)	41 (41.0)	15 (15.3)	169 (42.7)		
	F	79 (61.7)	47 (43.1)	26 (35.6)	15 (15.2)	167 (40.8)		
Pre-hypertension	M	30 (26.5)	20 (23.5)	25 (25.0)	22 (22.4)	97 (24.5)		
	F	24 (18.8)	26 (23.9)	11 (15.1)	15 (15.2)	76 (18.6)	73.047***	70.592***
Hypertension	M	12 (10.6)	23 (27.1)	34 (34.0)	61 (62.2)	130 (32.8)		
	F	25 (19.5)	36 (33.0)	36 (49.3)	69 (69.7)	166 (40.6)		
BMI (kg/m^2)	Sex	≤30	31-42	43-54	≥55	Total		
Non-obese	M	94 (83.2)	58 (68.2)	81 (81.0)	85 (86.7)	318 (80.3)		
	F	19 (16.8)	27 (31.8)	19 (19.0)	13 (13.3)	78 (19.7)		
Obese	M	104 (81.2)	65 (59.6)	52 (71.2)	86 (86.9)	307 (75.1)	11.013*	24.424***
	F	24 (18.8)	44 (40.4)	21 (28.8)	13 (13.1)	102 (24.9)		

Notes. M= Male, F= Female; Percentages are presented in the parentheses; Statistically significant at *** – p< 0.001; * – p< 0.05.

Примечание. M= мужчины, F= женщины; Проценты представлены в скобках, уровень значимости различий *** – p< 0.001; * – p< 0.05.

Table 5. Association between obesity and blood pressure among studied participants
Таблица 5. Связь между гипертонией и ожирением в изученной группе

BMI (kg/m^2)	Sex	Blood Pressure				χ^2
		Normal	Pre-hypertension	Hypertension	Total	
Obesity	Male	27 (16.0)	16 (16.5)	35 (26.9)	78 (19.7)	6.399*
	Female	30 (18.0)	22 (28.9)	50 (30.1)	102 (24.9)	7.373*
	Total	57 (17.0)	38 (22.0)	85 (28.7)	180 (22.4)	12.539**

Notes. Percentages are presented in the parentheses; Statistically significant at ** – p< 0.001; * – p< 0.05.
Примечание. Проценты представлены в скобках, уровень значимости различий ** – p< 0.001; * – p< 0.05.

Discussion

At present, obesity and hypertension are global major public health problems. In developing countries like India, the prevalence of obesity and hypertension has seen an increasing trend. The present study investigated obesity and blood pressure among rural adults of Daspur I Block, Paschim Medinipur, West Bengal, India. Our study has shown that females were more obese (24.9%) and hypertensive (40.6%) than males when standard cut-offs were used, and the differences were quite significant (p<0.05). Chi-square (χ^2) test analysis on blood pressure with age (years) showed a statistically significant (p<0.05) increase from younger age group to older age group in both sexes. Therefore, based on the findings, we can confirm that age (years) is a risk factor for obesity and hypertension among individuals.

The overall prevalence of hypertension in the present study was found to be 36,8%. Our study had revealed that obesity was associated with increasing blood pressure in both sexes, which indicated that obesity is a risk factor for hypertension. Our study exhibited that females had higher prevalence of hypertension than males, however studies from some countries from different parts of the world (Zambia, Ethiopia) had reported that the prevalence of hypertension was higher among males [Siziya et al., 2012; Haile et al., 2021].

Studies based in different Asian countries like Indonesia [Peltzer, Pengpid, 2018], Thailand [Soitong et al., 2021] and India [Ramkrishnan et al., 2019] has reported a lower prevalence of hypertension as compared with the present study. In Malaysia [Zaki et al., 2021] and Indonesia [Peltzer, Pengpid, 2018], the prevalence of hypertension has been reported to be higher among females, which supports the present study. However, some studies from Bangladesh [Rahman et al., 2021], Thailand [Soitong et al., 2021] and India [Ramkrishnan et al., 2019] have derived a higher prevalence of hypertension in males.

In the Indian context, a study based in Tamil Nadu [Gani et al., 2016] and in West Bengal [Chanak, Bose, 2018] has reported a very high prevalence of hypertension among females, which was much higher than the findings of the present study. Uttarakhand [Thapllyal et al., 2018] males (18.2%) and females (9.7%) showed a much lower prevalence of hypertension. There may be numerous reasons for increasing hypertension among rural adults, one reason being higher consumption of salt [Du et al., 2014]. Moreover, in rural settings hypertension is largely left untreated [Chowdhury et al., 2016].

In our study, the overall prevalence of obesity was 22.4%. It was derived from the present study that females possessed a higher risk for developing obesity as compared to males. A study conducted in Ethiopia [Darebo et al., 2019] had resulted in a higher prevalence of obesity among adults as compared to our study. In China, a study [Zhang et al., 2016] has concluded a lower prevalence (14.6%) of obesity than the present study. Similar to our finding, numerous previous studies in Ethiopia [Darebo et al., 2019] have concluded that the prevalence of obesity was higher among females; however, in Tanzania [Zubery et al., 2021] the prevalence of obesity was higher in males.

Concurrent to the present study, other studies from different Asian countries (India, Thailand, Saudi Arabia) have also reported higher prevalence of obesity among females as compared to males. However, in contrary to the present study, some studies from Southern China [Hu et al., 2017] and Nepal [Silvanus et al., 2018] have reported a higher prevalence of obesity among males (Fig.1).

In Indian context, the present study demonstrated that the prevalence of obesity among studied participants was higher (22.4%) as compared with some studies [Binu, Harnagle, 2014; Kumar et

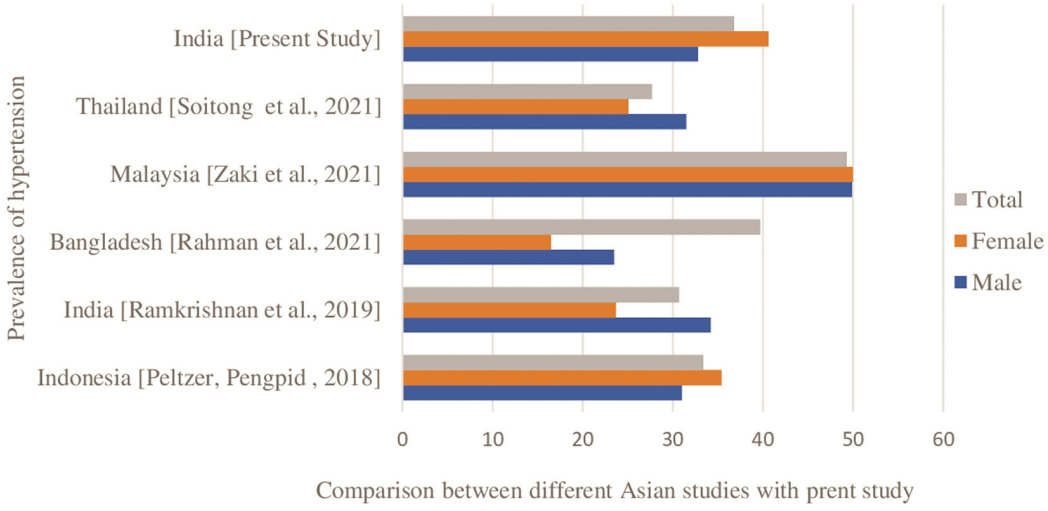

Figure 1. Comparison across different Asian studies on the prevalence of hypertension
Рис.1. Распространенность гипертонии в разных странах Азии

al., 2014; Chauhan et al., 2015; Easwaran et al., 2019] but lower than some other studies [Shrivastava et al., 2015; Undavalli et al., 2018; Karmakar et al., 2019]. Obesity was also more common in females in Punjab [Singh et al., 2019], Karnataka [Nagendra et al., 2017], West Bengal [Karmakar et al., 2019]. In India, there are many studies that have testified that the prevalence of obesity was higher in males as compared to females [Binu, Harnagle, 2014; Chauhan et al., 2015; Hadaye et al., 2020].

In the present study obesity and hypertension have significant impact with age (years) among both sexes. Among males, prevalence of hypertension increased from a lower age group (≤30 years) to upper age group (≥55 years). The prevalence of obesity increased from lower (≤30 years) to middle age groups (31-42 years and 43-54 years) for both males and females. Among males, the probability of getting obese with increase in age (years) was very high, however in case of female participants, middle aged individuals were more likely to get obese than older females as per the present study. Our study has emphasized that both male and female participants belonging to middle age (31–42 years and 43-54 years) group were obese which was similar to the findings of some recent studies in Bangladesh [Siddiquee et al., 2015], Iran [GhadiriAnari et al., 2014] but higher (≥50 years) age group was comparatively more obese in China [Wang et al., 2016] and Syria [Bakir et al., 2017].

In our study, we have found out that hypertension increased with increasing age (years) which is concurrent with different studies from Bangladesh [Chowdhury et al., 2016], Ethiopia [Haile et al., 2021] and India [Ramakrishnan et al., 2019]. However, in Ghana, it was derived from a study [Donkor et al., 2015] that hypertension was prevalent in younger population. Age (years) is a very important risk factor for both obesity and hypertension.

The present study focused on the impact of obesity and hypertension in rural adults, especially on females, which is a substantial health problem at present. There were many limitations in the present study, with the key limitation that the socio-economic variables have not been studied. Discussion of socio-economic variables would have helped us identify the reason for high prevalence of obesity and hypertension among rural population, especially in females, as to why is it so prevalent among middle aged and upper aged females. Despite so many limitations, the present study has illustrated a strong relationship of age (years) with obesity and hypertension.

Conclusion

The present study has exhibited a strong relationship between age (years) and the health conditions, obesity and hypertension. An interesting finding is that the prevalence of obesity was higher among middle aged females and showed no increase with increasing age (years). The health system should emphasize on the need to develop appropriate strategies including early diagnosis, health education programs, and national awareness campaigns for changing lifestyles should reach out to the rural population to reduce obesity and hypertension and also associated comorbidity and mortality.

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ГИПЕРТОНИЯ И ОЖИРЕНИЕ У ВЗРОСЛЫХ СЕЛЬСКИХ ЖИТЕЛЕЙ ПАШИМА

Введение. *Ожирение считается основной проблемой здравоохранения как в развитых, так и в развивающихся странах. Гипертония, как и ожирение, является источником повышенного риска смертности от всех причин, в том числе и от сердечно-сосудистых заболеваний. Часто эти два патологических состояния сопутствуют друг другу. Цель настоящего исследования состояла в том, чтобы выявить распространенность общего ожирения (ИМТ≥25,0) и гипертонии среди сельских взрослых жителей. Настоящее исследование позволило оценить возрастные тенденции развития ожирения и гипертонии среди сельских взрослых жителей блока Даспур I, района Пашим Мединипур.*

Материалы и методы. *Проведено поперечное исследовании 805 сельских взрослых жителей (396 мужчин; 409 женщины) блока Даспур I, район Пашим Мединипур, Западная Бенгалия, с августа по декабрь 2019 года.*

Результаты. *В настоящем исследовании общая распространенность ожирения составила 22,4% (19,7% у мужчин и 24,9% у женщин), а встречаемость гипертонии составила 36,8% (32,8% у мужчин и 40,6% у женщин). Распространенность как ожирения, так и гипертонии была намного выше в случае женщин-участниц. Процент обследованных с ожирением был выше среди мужчин и женщин среднего возраста. Выявлена значительная связь между ожирением и повышением артериального давления.*

Заключение. *Настоящее исследование выявило высокую распространенность ожирения и гипертонии среди сельских взрослых. В целом, риск ожирения и гипертонии был выше у женщин. Существует значительная связь между возрастом обследованных, ожирением и гипертонией.*

Ключевые слова: ожирение; кровяное давление; гипертония; сельские взрослые; возрастная группа, Индия