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EFFECTS OF GENDER AND AGE ON THE RELATIONSHIP BETWEEN BODY MASS INDEX AND HYPERTENSION OF ELDERLYRESIDENTS OF KOLKATA

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ABSTRACT

More than one billion people are hypertensive worldwide. This makes hypertension a public health issue. Therefore it is important for us to identify the risk factors of hypertension and suggest essential preventive measures to reduce this public health burden. Different studies have revealed that overweight, obesity and dyslipidemia are associated with hypertension. Studies reveal that Body Mass Index has been positively associated with hypertension both systolic blood pressure and diastolic blood pressure (Landi *et al*., 2018, Tang *et al*., 2022). Excessive weight gain or visceral fat gain is the most important risk factor of hypertension. Apart from this there may be several other factors like abdominal adiposity, family history, smoking etc. that may be responsible for hypertension. Keeping this backdrop in mind the present study would like to find out the association between Body Mass Index and hypertension of adults residing in Kolkata. The age range of the subjects would be 60 to 70 years and 70 to 80 years. The sample size of the present investigation would be 100, having equal representation from both the age groups and gender groups. The subjects would belong to middle socio economic status families as inferred from their occupations. Height, weight, systolic blood pressure and diastolic blood pressure would be measured. Body Mass Index would be calculated. Descriptive statistics, correlation coefficients and t test would be calculated. Impact of age and gender would be determined on Body Mass Index and hypertension scores of the subjects. The results reveal that there is a positive and significant correlation between the pertinent variables. The results of the t – Test revealed that there is significant difference between the Body Mass Index, systolic and diastolic blood pressure scores within the gender groups. The present study helps us to identify the population at risk and plan different preventive strategies to reduce the level of Body Mass Index and accordingly lower the level of hypertension.

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INTRODUCTION

Overweight and obesity are major community health concerns faced by our country in the present era. It is an important risk factor influencing both hypertension and cardiac problem for adults and elderly. The treatment of overweight and obesity requires a multidisciplinary approach including dietary management, physical activity and restriction of sedentary activity. Landi, *et al*.(1976) opined that blood pressure(SBP, DBP) increase with the level of Body Mass Index. The study also indicated that the Body Mass Index had a remarkable impact on the blood pressure of adults independent of other clinical risks. A study by Linderman, *et al*. (2018) stated that there is a substantial relationship between Body Mass Index, hypertension and cardiovascular diseases. The study was carried out in China where there is an increasing trend of obesity associated with hypertension and cardiovascular disease. In this study it was clear that weight loss could significantly reduce both systolic and diastolic blood pressure, which could eventually lower the probability of suffering from cardiovascular diseases. A study on the Punjabi community of India revealed that the relationship between Body Mass Index, fat percentage, and blood pressure, both systolic as well as diastolic are statistically significant (Dua, *et al*.,2014). Occurrence of hypertension among overweight and obese implied early detection of hypertension as a preventive measure along with life style modification and weight management. The changing lifestyle factors in India are a leading cause for the increase in the Body Mass Index and hypertension. This is true specially among the urban population of India (Srikanth *et al*., 2011). In an investigation by Kaufman *et al*., (1997) a significant linear relationship was established amidst Body Mass Index and hypertension of women and not men. In a study on the South Asian population of three countries, Bangladesh, Nepal and India, hypertension increased with age in men rather than women. The association of hypertension with Body Mass Index was consistent across variables such as age, gender and socioeconomic status (Hossain *et al*., 2019). Tang *et al*.,(2022) suggested in their investigation, the effect of Body Mass Index on dyslipidemia and hypertension in adults of China. Outcomes of the study by Tang *et al*., (2022) revealed that there was a significant impact of age on hypertension and it increased with the increase in age. It was also clear from the study that there was no significant impact of gender on

the relation between hypertension and Body Mass Index. Khalid *et al*., (2020) in their study opined that males have significant negative correlation in-between Body Mass Index and Hypertension whereas in females the correlation between the two variables was insignificant. Channanath *et al*., 2015 in there study revealed that during the onset of hypertension, age is inversely related to Body Mass Index in men compared to women. Therefore keeping in view the health perspective of the community or the society, it is of utmost importance to identify the population at risk. The present investigation helps to inquire the predominance of obesity and overweight among aged individuals and find out the levels of Body Mass Index and its relation to hypertension among them.

Age: In general, it refers to the chronological age of a person. Age is an important demographic variable. It exerts powerful influence on the development of characteristics of individuals.

Gender: It refers to the differences between men (male, masculine) and women (female, feminine). Gender has come to be associated with sex so much so that the two terms are used interchangeably. Sex is a biological fact. An individual is usually born either as a male or female. However, gender is conceptually different from sex. It is considered as a social construct that explains the fact of sex. When social scientists examine masculinity and femininity and the systems that are associated with them, they actually study and use gender as a category of both description and analysis.

Body Mass Index: Body mass index (BMI) is calculated from the weight and height of a person. The BMI can be explained as the ratio between body weight that is expressed in Kg and the square of the body height that is expressed in m^2. The unit of BMI therefore can be described as $kg/m^{2.}$.

Hypertension: According to World Health Organization, blood pressure is the pressure applied by the blood on the walls of the arteries. Blood pressure is measured by two numeric values, firstly the systolic pressure that is exerted on the blood vessels when the heart contracts and secondly the diastolic pressure that is exerted on the vessels when the heart is at rest between beats. Hypertension is the condition when the systolic blood pressure is $\geq$ 140mmHg and diastolic blood pressure $\geq$ 90mmHg.

MATERIALS AND METHODS

The objectives of the existent investigation was to detect the relationship between Body Mass Index and hypertension (both systolic blood pressure and diastolic blood pressure) of aged Bengali Hindu residents of Kolkata. The study also tried to find out the impact of age and gender on the Body Mass Index and Hypertension of the subjects.

Variables Selected: Based on the survey of research literature and in keeping with the goal of fulfilling the objectives of the investigation, Body Mass Index, systolic blood pressure, diastolic blood pressure, age and gender were selected as variables for the study. Age and gender was considered as independent variables. Body Mass Index, systolic blood pressure, diastolic blood pressure were considered as dependent variables.

Hypothesis of the Study

The alternative hypothesis of the study can be stated as follows:

i. There is significant relationship between Body Mass Index and systolic blood pressure of 60 to 69 years old residents of Kolkata.
ii. There is significant relationship between Body Mass Index and diastolic blood pressure of 70 to 79 years old residents of Kolkata.
iii. There is significant impact of age – level on Body Mass Index, systolic and diastolic blood pressure of 60 to 79 years old residents of Kolkata.
iv. There is significant impact of gender on Body Mass Index, systolic and diastolic blood pressure of 60 to 79 years old residents of Kolkata.

Anthropometric Measurements: For the purpose of assessing the variables, anthropometric measurements such as height, weight, systolic blood pressure and diastolic blood pressure were collected to serve the purpose of data collection. In the present investigation the height and weight of the subjects was used to calculate Body Mass Index of the subjects as recommended by WHO (1995). In addition to this the anthropometric measurements protocol was also maintained (Lohman *et al*. 1998).

Population of the study: The sample size was 200 comprising 60 to 79 year old aged residents of Kolkata. They were divided into two age groups (60 – 69years and 70 – 79 years). There was equal representation of males and females in each age group. There were 100 subjects belonging to 60 to 70 years and 100 were from 70 to 80 years. Equal numbers of subjects were included in each stratum of the sample from different parts of Kolkata.The subjects belonged to middle socio-economic status Hindu families of Kolkata, considering their occupations as reported by them and in some cases confirmed by their family members.

Data Analysis: After collecting the anthropometric measurements, the measurements were tabulated in Microsoft excel. Then the statistical analysis of the tabulated data was carried out. Calculation of means, standard deviations, product – moment correlation coefficients for the respective correlations was done. t- Test was calculated to understand the impact of age and gender on the Body Mass Index and systolic and diastolic blood pressure measurements of the subjects.

RESULT AND DISCUSSION

Means and Standard Deviations: At the outset, the descriptive statistics i.e., the mean and standard deviation values for the age – groups and the gender – groups within each age – group and also the entire sample were calculated. These values are represented in the following Table 1 and Table 2. The mean scores reported in Table 1 do not appear to differ much with the change in age or gender. The standard deviation values reported in Table 1 indicate moderate levels of homogeneity. The mean scores reported in Table 2 do not appear to differ much with the change in age. Both the mean of the systolic blood pressure and the diastolic blood pressure is more in females compared to males. The standard deviation values reported in Table 2 indicate moderate levels of homogeneity.

Correlation Coefficients: To probe the relations among the pertinent variables of the investigation, correlation coefficients between pairs of these variables were computed for the entire sample and for the two age – groups separately. The correlations between pairs of the relevant variables for the entire sample (N = 200) are graphically represented in Figures 1 to 6. Table 3 shows that the relationship between Body Mass Index, systolic and diastolic blood pressure for the entire population and also for the separate age groups are positive and significant. Therefore, the first and the second alternative hypothesis was accepted. This was also true according to the findings of the study on association of Body Mass Index with blood pressure by Linderman *et al*. (2018). The findings are in lieu with the outcomes of the investigation by Ravisankar *et al*. (2005). Table 4 shows that there is a positive and significant correlation between Body Mass Index, systolic and diastolic blood pressure for the separate gender groups. The first and the second alternative hypothesis is thus accepted. The results is also similar to the outcomes of the study by Khalid *et al*. (2020). Ravisankar *et al*. (2005) also highlight the same finding in their investigation.

Table 1. Means and Standard Deviations of the Height and Weight

Independent Variables		Height (ft)		Weight (Kg)	
		Mean	Standard Deviation	Mean	Standard Deviation
Age	60 - 79 years	5.56	0.27	77.11	6.97
	60–69 years	5.56	0.27	76.94	7.14
	70 - 79 years	5.55	0.28	77.2	6.83
Gender	Male	5.78	0.17	78.44	6.74
	Female	5.33	0.13	75.78	6.98

Table 2. Means And Standard Deviations of The Body Mass Index, Systolic Blood Pressure and Diastolic Blood Pressure

Independent Variables		BMI (Kg/m²)		Systolic Pressure (mmHg)		Diastolic Pressure (mmHg)	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Age	60 - 79 years	27.74	3.13	143.02	22.9	92.02	9.09
	60 – 69 years	27.63	3.2	142.49	23.24	92.25	9.32
	70 - 79 years	27.79	3.19	143.29	22.61	91.71	8.91
Gender	Male	26.17	2.77	131.31	14.33	88.83	8.11
	Female	29.31	2.79	154.74	23.91	95.21	8.93

Table 3. Age Wise Depiction of Correlation Coefficients Among Relevant Variables

Age Group	Correlation between Body Mass Index and Systolic Blood Pressure	Correlation between Body Mass Index and Diastolic Blood Pressure
60 - 79 years	0.740**	0.734**
60 - 69 years	0.708**	0.745**
70 - 79 years	0.773**	0.716**

** p < .01

Table 4. Gender Wise Depiction of Correlation Coefficients Among Relevant Variables

Gender Group	Correlation between Body Mass Index and Systolic Blood Pressure	Correlation between Body Mass Index and Diastolic Blood Pressure
Male	0.603**	0.690**
Female	0.715**	0.688**

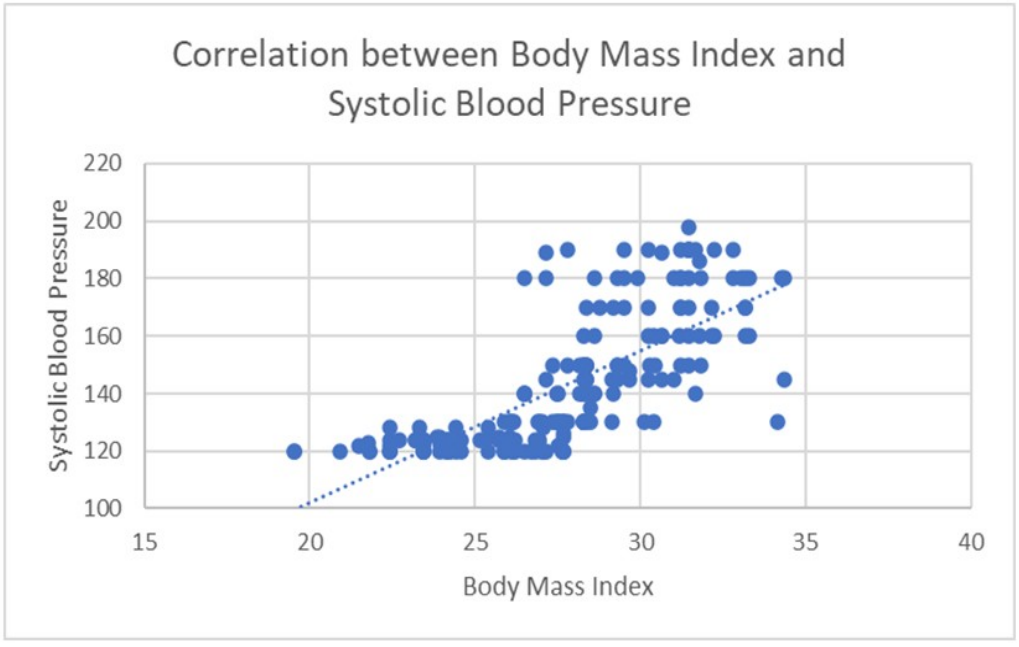

Figure 1. Scatter Diagram showing the Correlation between Body Mass Index and Systolic Blood Pressure of 60 – 79 years old Aged Residents of Kolkata

Figure 1 shows that there is a linear correlation between Body Mass Index and systolic blood pressure of the aged residents of Kolkata. The relationship among the two variables is positive and significant. Figure 2 shows that there is a linear correlation between Body Mass Index and diastolic blood pressure of the aged residents of Kolkata. The relationship among the two variables is positive and significant.

Figure 3 shows that there is a linear correlation between Body Mass Index and systolic blood pressure of the aged male residents of Kolkata. The relationship among the two variables is positive and significant. Figure 4 shows that there is a linear correlation between Body Mass Index and diastolic blood pressure of the aged male residents of Kolkata. The relationship among the two variables is positive and significant.

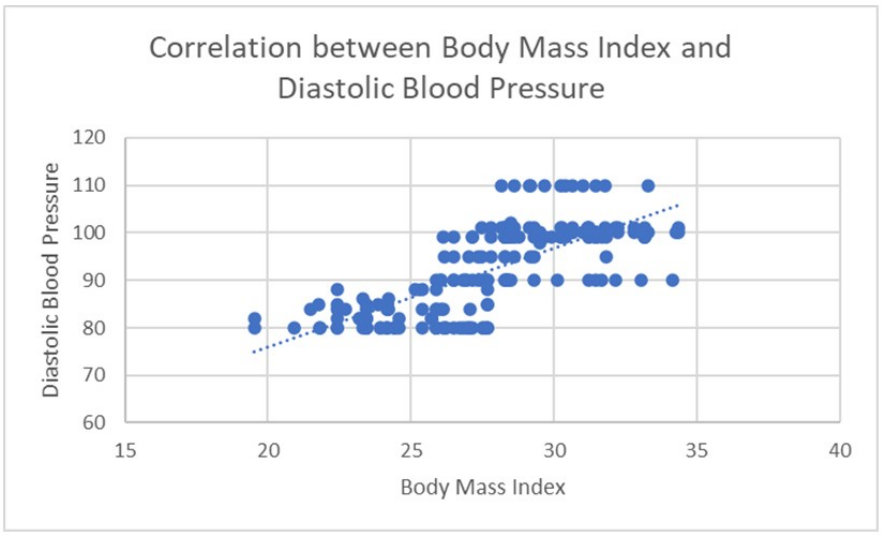

Figure 2. Scatter Diagram showing the Correlation between Body Mass Index and Diastolic Blood Pressure of 60 – 79 years old Aged Residents of Kolkata

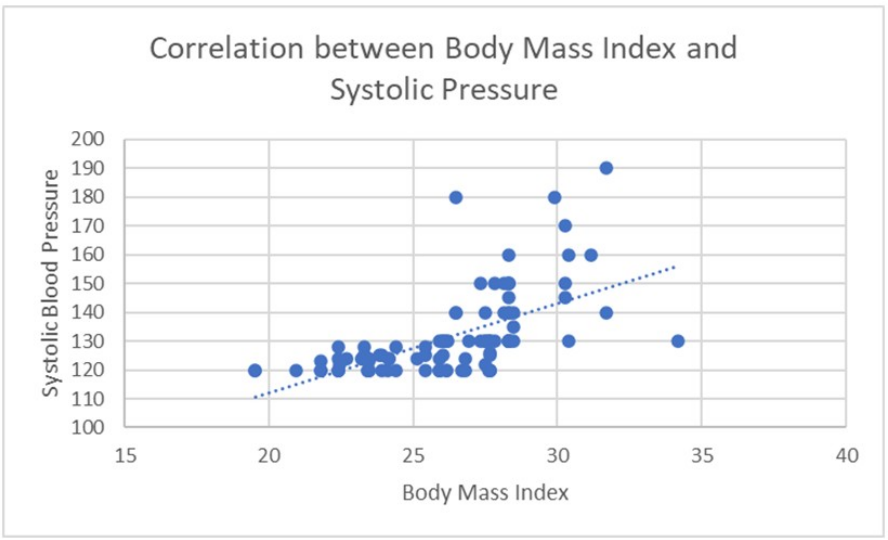

Figure 3. Scatter Diagram showing the Correlation between Body Mass Index and Systolic Blood Pressure of 60 – 79 years old, Male Residents of Kolkata

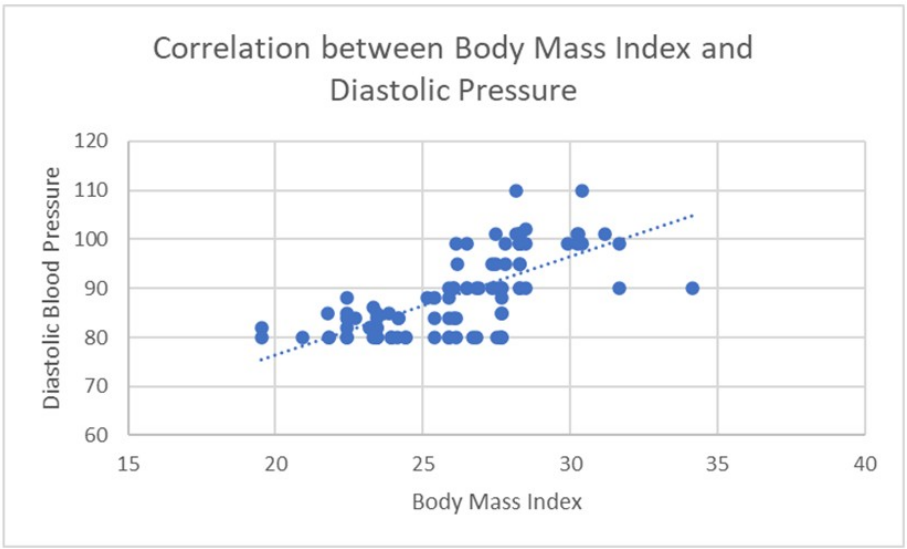

Figure 4. Scatter Diagram showing the Correlation between Body Mass Index and Diastolic Blood Pressure of 60 – 79 years old, Male Residents of Kolkata

Figure 5 shows that there is a linear correlation between Body Mass Index and systolic blood pressure of the aged female residents of Kolkata. The relationship among the two variables is positive and significant. Figure 6 shows that there is a linear correlation between Body Mass Index and diastolic blood pressure of theaged female residents of Kolkata. The relationship among the two variables is positive and significant.

The investigation by Thapa *et al*. (2022) discussed that Body Mass Index and blood pressure has a significant correlation through different age groups. A similar finding was also highlighted in a study by Koh *et al*. (2022). In a study by Vuvor (2017) the results revealed similar results too.

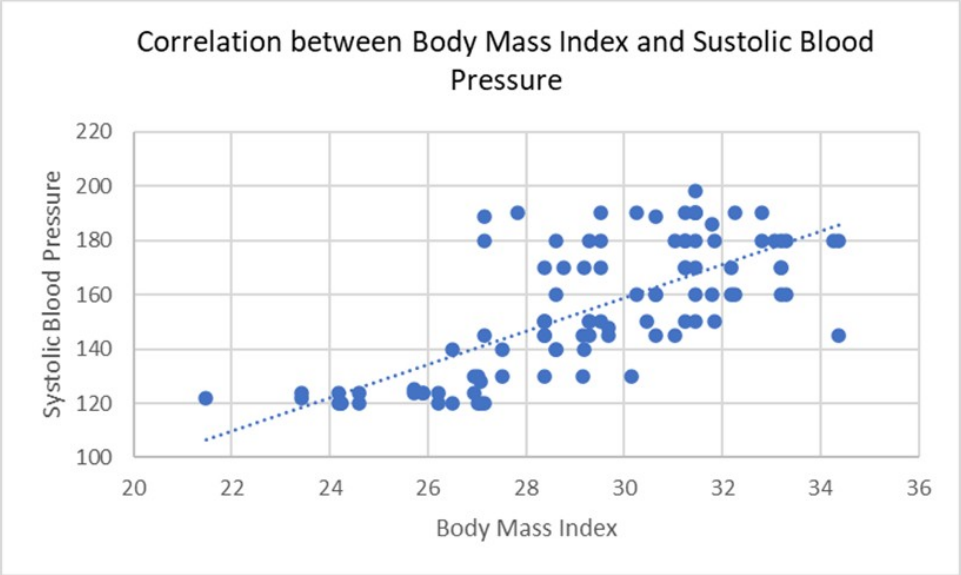

Figure 5. Scatter Diagram showing the Correlation between Body Mass Index and Systolic Blood Pressure of 60 – 79 years old, Female Residents of Kolkata

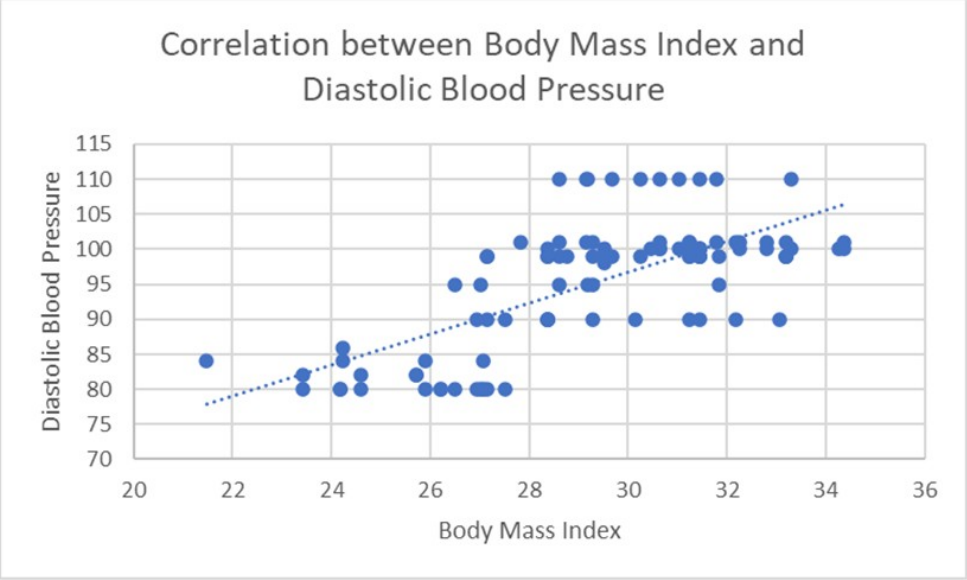

Figure 6. Scatter Diagram showing the Correlation between Body Mass Index and Diastolic Blood Pressure of 60 – 79 years old, Female Residents of Kolkata

Table 5. Result of t – Test for the difference in mean scores of Body Mass Index, Systolic Blood Pressure and Diastolic Blood Pressure

Dependant Variables	Independent Variables	t cal.	df	t crit. 0.05	Inference
Body Mass Index	Age	0.433	98	1.66	The difference is non - significant at 0.05 level of significance
	Gender	7.946	98	1.66	The difference is significant at 0.05 level of significance
Systolic Blood Pressure	Age	0.308	98	1.66	The difference is non - significant at 0.05 level of significance
	Gender	7.973	98	1.66	The difference is significant at 0.05 level of significance
Diastolic Blood Pressure	Age	0.577	98	1.66	The difference is non - significant at 0.05 level of significance
	Gender	5.296	98	1.66	The difference is significant at 0.05 level of significance

The above tables and figures help to conclude that the relationship between the pertinent variables is positive and significant. This is true not only through the age groups but also through the gender groups.

T – Test: To find out whether the two samples significantly differ in their mean Body Mass Index, systolic blood pressure and diastolic blood pressure scores, t – test was conducted. The results of the t – test is reported in Table 5. Table 5 represents that the difference in the

mean scores of Body Mass Index, systolic blood pressure and diastolic blood pressure of the two age groups are nonsignificant. The difference is significant at 0.05 level of significance for the two gender groups. Therefore, the third null hypothesis is accepted rejecting the alternative hypothesis. Moreover, the fourth alternative hypothesis is accepted in the present study. This was also revealed in a study by Karlsson *et al*.(2020) which stated that there is no association between age and Body Mass Index, though Body Mass Index can be driven by environmental factors and therefore can be modifiable. Jarrett, B. L. (2009) also stated that the effect of age on Body Mass Index was non significant. The investigation by Gurven *et al*. (2012) depicts similar outcomes regarding the impact of age and gender on systolic blood pressure and diastolic blood pressure of adults. In a study by Rockwood and Howlett (2011) results revealed that there was no significant influence of age on blood pressure also . The positive impact of gender on Body Mass Index has also been depicted in an investigation by Reas *et al*.(2007). Similar outcomes regarding gender and its impact on blood pressure has been discussed in a study by Reckelhoff, J. F.(2001) where she explains that elderly women are more prone to higher blood pressure after menopause compared to their similar aged counterparts.

CONCLUSION

The influence of Body Mass Index on physical and psychological health of an individual is profound. Body Mass Index is significantly related to hypertension, one of the major factors of severe health issues. The condition of underweight, overweight and obesity have global impact on the public health consequences. The present investigation has tried to reflect the effect of Body Mass Index on Hypertension (Systolic and Diastolic). As the study tries to uncover the relationship among Body Mass Index and hypertension in aged (60 – 79years) residents of Kolkata, it also tries to find out the influence of age and gender on the pertinent variables. The study helps us to understand that there is a positive and significant correlation between Body Mass Index and hypertension ofaged residents of Kolkata. This finding is true for the entire sample and also for the two age groupsindependently. The result is at par with the results of previous investigations where a positive and linear significance is depicted among blood pressure and Body Mass Index of adults. The study predicts that Body Mass Index may cause a direct impact on blood pressure independent of other comorbid factors. The result from the t – Test revealed that their was no significant impact of age on Body Mass Index, Systolic Blood Pressure and Diastolic Blood Pressure of aged Bengali Hindu residents of Kolkata. Gender seems to have significant impact on the scores of the variables mentioned. This was in lieu with the findings where the researchers stated that the relationship between Body Mass Index and blood pressure were influenced by gender and not by age. Results reveal that women seem to have higher blood pressure compared to men. This may be due to the premenopausal and post-menopausal impact. This may also be due to the complicated comorbid condition like obesity, diabetes, cardiovascular diseases, polycystic ovary syndrome and adrenal virilizing tumours. According to the present study the association between Body Mass Index and blood pressure is strong in the population. Low body weight is a defensive factor for hypertension whereas the risk factors of hypertension are overweight, obesity and dyslipidemia. Therefore, community health measures to reduce Body Mass Index in the community or society would surely help in reducing the risk of hypertension.

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Conflict of Interest: There was no conflict of interest.

Statement of Ethical Consent: The present study adhered to the ethical standards of the research. Participants consent was taken and they were informed accordingly about the study.

REFERENCES

Bose, K., Ghosh, A., Roy, S., Gangopadhyay, S. (2003). Blood pressure and waist circumference: An empirical study of the effects of waist circumference on blood pressure among Bengalee male jute workers of Belur, West Bengal, India. *J Physiol Anthropol Appl Hum Sci.* 22: 169–73.

Bloch, G. J., Bennett, D.(2009). The influence of Body Mass Index on Age and Gender on Current illness: A crossecctional study. International Journal of Obesity. 34. Doi.org/10.1038/ ijo.2009.258.

Bulpitt, C. J., Hodes, C., Everitt, M. G. (1976). The relationship between blood pressure and biochemical risk factors in a general population. *Br J Prev Soc Med.* 30: 158–62.

Cassani Roerta, S. L., Nobre, F., Pazin-Fiho, A., Schmidt, A. (2009). Relationship between blood pressure and anthropometry in a cohort of Brazilian men: A cross-sectional study. *Am J Hypertens.* 22: 980–4.

Channanath, A.M., Farran, B., Behbehani, K., Thanaraj, T.A.(2015). Association between body mass index and onset of hypertension in men and women with and without diabetes: a cross-sectional study using national health data from the State of Kuwait in the Arabian Peninsula. *BMJ Open*,5(6):e007043. http:// doi: 10.1136/bmjopen-2014-007043..

Diet nutrition and the prevention of Chronic diseases. (1990). Report of WHO study group. *Word Health Organisation.* WHO Technical.

Doll, S., Paccaud, F., Bovet, P., Burnier, M., Wietlisbach, V. (2002). Body mass index, abdominal adiposity and blood pressure: Consistency of their association across developing and developed countries. *Int J Obes Relat Metab Disord.* 26: 48–57.

Dua, S., Kapoor, S. (2000). Blood pressure, waist to hip ratio and body mass index among affluent Punjabi girls of Delhi. *Acta Med Auxol.* 32: 153–7.

Ferguson, T.S., Younger, N.O., Tulloch-Reid, M.K., Wright, M.B., Ward, E.M., Ashley, D.E. (2008). Prevalence of prehypertension and its relationship to risk factors for cardiovascular disease in Jamaica: Analysis from a cross- sectional survey. *BMC Cardiovasc Disord.* 8: 20.

Gardner, A. W., Poehlman, E. T. (1995). Predictors of age related increase in blood pressure in men and women. *J Gerontol A Biol Sci Med Sci.* 50: 1–6.

Gupta, R., Mehrishi, S. (1997). Waist-hip ratio and blood pressure correlation in an urban Indian population. *J Indian Med Assoc.* 95: 412–5.

Gupta, S., Kapoor, S. (2010). Sex differences in blood pressure levels and its association with obesity indices: Who is at greater risk. *Ethn Dis.* 20: 370–4.

Gurven, M., Blackwell, A. D., Rodríguez, D. E., Stieglitz, J., Kaplan, H.(2012). Does Blood Pressure Inevitably Rise With Age?Longitudinal Evidence Among Forager-Horticulturalists. *Hypertension*. 60:25–33. http://doi.org/ 10.1161/hypertensionaha. 111.189100.

Hazarika, N.C., Narain, K., Biswas, D., Kalita, H.C., Mahanta, J. (2004). Hypertension in the native rural population of Assam. *Natl Med J India.* 17: 300–4.

Hossain, F.B., Adhikary, G., Chowdhury, A.B., Shawon, M. S. R., (2019). Association between body mass index (BMI) and hypertension in south Asian population: evidence from nationally-representative surveys. *Clin Hypertens,* 25(28). https://doi.org/10.1186/s40885-019-0134-8.

Freedman, D.S., Perry, G. (2000). Body composition and health status among children and adolescents. *Prev Med.* 31: 34–53.

Jarrett, B. L.(2009). The influence of body mass index, age and gender on current illness: A cross-sectional study. *International Journal of Obesity.* 34(3):429-36. http://doi.org/ 10.1038/ ijo.2009.258.

Jervase, E., Barnabas, D., Emeka, A.G., Osondu, N. (2009). Sex differences and Relationship between blood pressure and age among the Igbos of Nigeria. *Internet J Biol Anthropol. 15:* 3–2.

JNC 7. (2003). The seventh report of the joint national committee on prevention, detection, evaluation and treatment of high blood pressure. *JAMA.* 289: 2560–71.

Kannel, W.B. (2000). Risk stratification in hypertension: New insight from the Framingham study. *Am J Hypertens.* 13: 3S–10.

Kapoor, S., Dhall, M., Kapoor, A. K. (2010). Nutritional status and ageing among populations. Inhabiting varied geological regions in India. *Biennial Book of EAA.* 6: 85–100.

Karlsson, I. K., Lehto, K., Gatz, M., Reynolds, C. A., Aslan, A. K. D.(2020). Age-dependent effects of body mass index across the adult life span on the risk of dementia: a cohort study with a genetic approach. *BMC Medicine*. 18(131). https://doi.org/10.1186/s12916-020-01600-2.

Kaufman, J.S., Asuzu, M.C., Mufunda, .J, Forrester, T., Wilks, R., Luke, A., Long, A.E., Cooper, R.S.(1997). Relationship between blood pressure and body mass index in lean populations. *Hypertension*, 30(6),1511-6. https://doi.org/10.1161/01.HYP.30.6.1511.

Khalid, F., Siddique, A., Siddiqui, J. A., Panhwar, G., Singh, S., Adnan Anwar,A., Atif Hashmi A. (2020). Correlation Between Body Mass Index and Blood Pressure Levels Among Hypertensive Patients: A Gender-Based Comparison. *Cureus*. 12(10): http:// doi: 10.7759/cureus.10974.

Koh, H. B., Heo, G. Y., Kim, K. W., Ha, J., Park, J. T., Han, S. H., Yoo, T. H., Kang, S. (2022). Trends in the association between body mass index and blood pressure among 19-year-old men in Korea from 2003 to 2017. *Scientific Reports*. 12(6767), https://doi.org/10.1038/s41598-022-10570-9

Kusuma, Y.S., Babu, B.V., Naidu, J.M. (2002). Blood pressure levels among cross cultural/populations of Visakhapatnam district, Andhra Pradesh, India. *Ann Hum Biol.* 29: 502–12.

Landi, F., Calvani, R., Picca, A., Tosato, M., Martone, A. M., Ortolani, E., Sisto, A., Angelo, E. D., Serafini, E., Desideri, G., Fuga,M. T., Marzetti, E. (2018). Body Mass Index is Strongly Associated with Hypertension: Results from the Longevity Check-Up 7+ Study. *Nutrients*, 10(12): http://doi.org/:10.3390/nu.10.12.1976.

Linderman, G. C., Jiapeng, L., Yuan, L., Xin, S., Wei, X., Khurram, N., Wade, S., Lixin, J., Harlan, M. K. (2018). Association of Body Mass Index With Blood Pressure Among 1.7 Million Chinese Adults. *JAMA. 1(4)* http://doi.org/:10.1001/jamanetworkopen.2018.1.4.1271.

Lohman, T. G., Roche, A. F. & Martorell, R. (1988). Anthropometric Standardization Reference Manual. Human Kinetics Books, Chicago.

Mendelsohn, M.E., Karas, R.H. (1999). The protective effects of estrogen on the cardiovascular system. *N Engl J Med.* 340: 1801–11.

Nutrition Foundation of India . *Obesity in urban middle class in Delhi.* 1999 Scientific Report 15.

Okosun, I. S., Prewitt, T.E., Cooper, R. S. (1999). Abdominal obesity in the United States: Prevalence and attributable risk of hypertension. *J Hum Hypertens.* 13: 425–30.

Poulter, N. R., Khaw, K.T., Hopwood, B. E., Mugambi, M., Peart, W. S., Rose, G. (1990). The Kenyan Luo migration study: Observations on the initiation of a rise in blood pressure. *BMJ.* 300: 967–72.

Ravisankar, P., Madanmohan, K. U., Sankaranarayanan, P.(2005). Correlation Between Body Mass Index And Blood Pressure Indices, Handgrip Strength And Handgrip Endurance In Underweight, Normal Weight And Overweight Adolescents. Indian J Physiol Pharmacol. 49 (4) : 455–461.

Rebuffle-Strive, M., Bjorntopp, P. (1985). Regional adipose tissue metabolism in man. *Metabolic complications of human obesities.* 149–59.

Reas, D. L., Nygård, J. F., Svensson, E., Sørensen, T., Sandanger, I.(2007). Changes in body mass index by age, gender, and socio-economic status among a cohort of Norwegian men and women (1990–2001). *BMC Public Health*. 7(269). https://doi.org/10.1186 1471-2458-7-269.

Reckelhoff, J. F.(2001). Gender Differences in the Regulation of Blood Pressure. *Hypertension*. 37:1199–1208. https://doi.org/10.1161/01.HYP.37.5.1199.

Rockwood, M. R. H., Howlett, S. E.(2011). Blood Pressure in Relation to Age and Frailty. *Can Geriatr J.* 14(1): 2–7. http://doi.org/10.5770/cgj.v14i1.1.

Rohrer, J.E., Anderson, G.J., Furst, J. W. (2007). Obesity and prehypertension in family medicine: Implications for quality improvement. *BMC Health Serv Res.* 7: 212.

Shanthirani, C.S., Pradeepa, R., Deepa, R., Premalatha, G., Saroja, R., Mohan, V. (2003). Prevalence and risk factors of hypertension in selected South Indian population – The Chennai Urban Population Study. *J Assoc Physician India.* 51: 20–7.

Shetty, P.S., James, W.P. (1994). Body Mass Index: A measure of chronic energy deficiency in adults. *Food and Nutrition paper. 56:* 156 – 164.

Srikanth, J., Jayant, K. K., Narasimha, N.S. (2011). Factors influencing obesity among urban high school children Bangalore City. *Indian J Nutr Dietet.* 48: 8–17.

Sorof, J., Daniels, S. (2002). Obesity and Hypertension in children: A problem of epidemic proportions. *Hypertension.* 40: 441–7.

Stamler, J., Stamler, R., Reidlinger, W.F., Algera, G., Roberts, R.H. (1976). Hypertension screening of 1 million Americans. Community Hypertension Evaluation Clinic (CHEC) Program. *JAMA.* 235: 2299–306.

Tang N, Ma J, Tao R, Chen Z, Yang Y, He Q, Lv Y, Lan Z, Zhou J. (2022). The effects of the interaction between BMI and dyslipidemia on hypertension in adults. *Sci Rep*, 18;12(1):927. http://doi.org/ 10.1038/s41598-022-04968-8.

Thapa B, K. C. D., Shrestha, K., Gurung, S.(2022). Association between body mass index and blood pressure among adults. *JGMC Nepal*, 15(1),59-62. http://doi.org/10.3126/jgmcn.v15i1.43157.

Tyagi, R. (2007). Body composition and nutritional status of the institutionalised and non-institutionalised senior citizens. *EAA Summer School eBook.* 1: 225–2319.

Vuvor, F.(2017). Correlation of body mass index and blood pressure of adults of 30–50 years of age in Ghana. *Journal of Health Research and Reviews in Developing Countries*. 4(3), 115 - 121. https://www.jhrr.org/text.asp?2017/4/3/115/216068.

Wang, H., Cao, J. Li. J., Chen, J., Wu, X., Duan, X. (2010). Blood pressure, body mass index and risk of cardiovascular disease in Chinese men and women. *BMC Public Health.* 10: 189.

WHO expert consultation. (2004). Appropriate body mass index for Asian population and its implication for policy and intervention strategies. *Lancet.* 363: 157–63.

Weiner, J.S., Lourie, J.A. (1981). *Practical human Biology Anthropometry.* New York: Academic Press, 27- 54.

Wolf-Maier, K., Cooper, R.S., Banegas, J.R., Giampaoli, S., Hense, H.W., Joffres, M. (2003). Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. *JAMA.* 289:2363–9.

World Health Organization. (1995). Physical Status: The

Use and Interpretation of Anthropometry, Report of the WHO Expert Committee,Technical Report Series, No.854., World Health Organization, Geneva.

Yusuf, S., Hawken, S., Ounpuu, S., Bautista, L., Franzosi, M.G., Commerford, P. (2005). INTERHEART. Study Investigators. Obesity and risk of myocardial infarction in 27,000 participants from 52 different countries: A case control study. *Lancet.* 366:1640–9.

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