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Research Paper

Relationship between Body Mass Index, Waist Circumference, and Waist-hip Ratio with Hypertension among the Middle Age People of Uttar Pradesh

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ABSTRACT

It is crucial for the development of hypertension to occur during middle age. The combined impact of genetics, age-related physiological changes, and lifestyle variables raises the risk. The rising incidence of hypertension in young and middle-aged people is highlighted by (Zhang et al., 2022), which also stresses the significance of self-management, therapy, and awareness. The purpose of the study was to find the Relationship between Body Mass Index, Waist Circumference, and Waist-hip Ratio with Hypertension among the Middle Age People of Uttar Pradesh. 200 middle-aged people ranged 35 to 55 years from four different metropolitan cities of Uttar Pradesh such as Lucknow, Prayag Raj, Kanpur, and Jhansi were selected as subject for the study. Data was collected on the following variables: Height, Body weight Hip and waist circumference and Blood Pressure. Pearson product-moment correlation was used. Descriptive Statistics was selected to calculate the data, while an independent t-test had been taken to compare values obtained for male and female participants. Logistic regression analysis was utilized. The level of Significance was at 0.05. The findings revealed significant positive correlations between the anthropometric measures and systolic and diastolic blood pressure (the two components of hypertension). Among the variables, Waist Circumference (WC) stood out as the most consistent and strong predictor of hypertension, especially for both systolic and diastolic blood pressure. Waist-hip ratio (WHR) and Body Mass Index (BMI) also showed significant associations with these health conditions, although to a slightly lesser extent.

Keywords: *Hypertension, Body Mass Index (BMI), Waist Hip Ratio (WHR), waist circumference (WC)*

Lack of activity destroys the good condition of every human being while movement and methodical physical exercise save it and preserve it.

The relationship between excess weight and diseases has been recognized over time (Visscher and Seidell, 2001; Cameron et al, 2003). Obesity has been particularly recognized as a major independent risk factor for cardiovascular diseases (Despres, 2001). This is because increased body fat is accompanied by profound changes in the physiological and metabolic functions of the body, which are directly dependent on the degree of excess

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weight and its distribution around the body. The prevalence of obesity is rising in developed and developing nations, and it is cited as an important risk factor for early mortality (WHO, 1998). Obesity has a strong relationship with cardiovascular diseases like hypertension (Stevens et al, 1998; Despres, 2001; Cameron et al, 2003), coronary heart disease and diabetes. Several clinical measurements for obesity have been used to determine susceptibility to cardiovascular diseases (Cameron et al, 2003). These include anthropometric indices such as body mass index (BMI), waist-hip ratio (WHR) and waist circumference (WC) (Bray and Gray, 1988; Flier and Flier, 2005). Body mass index has been identified by the World Health Organization as the most useful epidemiological measure of obesity. It is nevertheless a crude index that does not take into account the distribution of body fat, resulting in variability in different individuals and populations (WHO, 2000). In the assessment of obesity, the central distribution of body fat cannot be overlooked, hence, the use of other anthropometric indices such as WC and WHR, as measures of adiposity (Welborn et al, 2003). Waist circumference has been recommended as a simple and practical measure for identifying overweight and obese patients. It is particularly useful for individuals and population groups with different body builds (Larson et al,1984; Lapidus et al, 1984; Welborn et al, 2003).

The study aims to find out the Relationship between body mass index, waist circumference, waist hip ratio, and hypertension among middle-aged people in Uttar Pradesh.

METHODOLOGY

Subjects

Subjects for the study will be selected from four different metropolitan cities of Uttar Pradesh such as Lucknow, Prayag Raj, Kanpur, and Jhansi. A total of 200 middle-aged people will be selected as subjects. Age of the Subjects will be ranging from 35 to 55 years. All the subjects will be divided according to their age & gender (male & female). The test may be conducted at the subject’s residence or their workplaces with their concern and care will be taken to include the subjects belonging to various socio-economical status.

Cities	No. of subjects
Lucknow	50
Prayag Raj	50
Kanpur	50
Jhansi	50

Variables

1. Body Mass Index
2. Waist-Hip Ratio
3. Waist Circumference
4. Blood Pressure
5. Sugar level

Measurements

1. Weight will be measured in Kilograms and a portable weighing machine will be used for this purpose.
2. Waist & hip circumference and height shall be measured in centimeters by a measuring tape and height measuring apparatus respectively.

3. Blood Pressure will be measured by sphygmomanometer.
4. 4.Sugar level will be measure by glucose meter (Glucometer).

Administration of the test

All the measurements regarding height, weight, waist, and hip circumference will be taken at their residence or workplaces according to suitability. Before the actual administration of the test and taking the measurements, all the subjects will be well-oriented about the purpose of the study.

Data will be collected on the following variables:
- Height
- Body weight
- Hip and waist circumference
- Blood Pressure

Statistical Analysis

To find out the relationship between body mass index, waist circumference, and waist-hip ratio with hypertension & diabetes, Pearson product-moment correlation will be used. Descriptive Statistics will also be calculated, while an independent t-test will be used to compare values obtained for male and female participants. Logistic regression analysis will be utilized. The level of Significance will be chosen at .05.

RESULTS AND ANALYSIS OF THE DATA

Part: A Relationship between Body Mass Index, Waist Circumference, Waist-Hip Ratio with Hypertension among Middle Age People of Uttar Pradesh.

Table 1: Descriptive Statistical Analysis of BMI, WHR, Waist Circumference, Systolic Blood Pressure, Diastolic Blood Pressure.

	N	Minimum	Maximum	Mean	Std. Deviation
BMI	200	19.10	30.30	25.3985	2.35356
WHR	200	.77	.99	.8815	.06328
Waist Circumference	200	30.20	42.60	36.2730	2.61335
Systolic Blood Pressure	200	132.00	164.00	146.5000	5.83095
Diastolic Blood Pressure	200	82.00	100.00	91.0250	3.74359

Table 1 provides a descriptive statistical analysis of six health parameters—Body Mass Index (BMI), Waist-to-Hip Ratio (WHR), Waist Circumference, Systolic Blood Pressure, and Diastolic Blood Pressure, —based on data from 200 participants. BMI values range from 19.10 to 30.30, with a mean of 25.40 and a standard deviation of 2.35, indicating that the sample leans toward the overweight category with moderate variability. WHR ranges from 0.77 to 0.99, with an average of 0.8815 and a standard deviation of 0.063, reflecting low variability and a moderate risk of central adiposity. Waist Circumference spans from 30.20 cm to 42.60 cm, averaging 36.27 cm with a standard deviation of 2.61, showing moderate dispersion. Blood pressure readings reveal a systolic range of 132 mmHg to 164 mmHg and a diastolic range of 82 mmHg to 100 mmHg, with means of 146.50 mmHg and

91.03 mmHg, respectively. These values suggest that the sample predominantly exhibits hypertensive characteristics, with standard deviations of 5.83 mmHg for systolic and 3.74 mmHg for diastolic pressure, indicating moderate variability. Overall, the data highlights a sample with tendencies toward overweight and central obesity, elevated blood pressure.

Table 2: Correlation of Body Mass Index, Waist-Hip Ratio and Waist Circumference with Hypertension

Variable	Pearson Correlation	Sig. (2-tailed)	N
BMI with Systolic Blood Pressure	0.417**	0.000	200
WHR with Systolic Blood Pressure	0.308**	0.000	200
Waist Circumference with Systolic Blood Pressure	0.489**	0.000	200
BMI with Diastolic Blood Pressure	0.373**	0.000	200
WHR with Diastolic Blood Pressure	0.487**	0.000	200
Waist Circumference with Diastolic Blood Pressure	0.501**	0.000	200

***Significant at 0.01 Level*

Table 2 presents the results of a correlation analysis between anthropometric measures—Body Mass Index (BMI), Waist Circumference, and Waist-Hip Ratio (WHR)—and hypertension indicators, namely Systolic and Diastolic Blood Pressure, in a sample of 200 participants. All correlations were assessed using Pearson's correlation coefficient and were found to be statistically significant at the 0.01 level.

BMI showed a moderate positive correlation with Systolic Blood Pressure (r = 0.417) and Diastolic Blood Pressure (r = 0.373), indicating that higher BMI is associated with increased blood pressure levels. Similarly, WHR exhibited a weaker yet significant positive correlation with Systolic Blood Pressure (r = 0.308) but a stronger correlation with Diastolic Blood Pressure (r = 0.487). Waist Circumference demonstrated the strongest correlations with both Systolic Blood Pressure (r = 0.489) and Diastolic Blood Pressure (r = 0.501), suggesting it may serve as the most reliable anthropometric indicator of hypertension risk among the variables studied. These findings highlight the significant relationship between obesity-related measures and blood pressure, with Waist Circumference emerging as a particularly strong predictor of hypertension.

Part B: Comparative Analysis of Body Mass Index, Waist Circumference, Waist-Hip Ratio, Hypertension Between Male and Female Middle Age People of Uttar Pradesh.

Table 3 Descriptive Statistics of Body Mass Index, Waist Circumference, Waist-Hip Ratio, Hypertension among Male and Female

	GENDER	N	Mean	Std. Deviation
BMI	MALE	112	24.732	2.34144
	FEMALE	88	26.2580	2.08358
WHR	MALE	112	.9321	.02770
	FEMALE	88	.8171	.02642
Waist Circumference	MALE	112	37.5893	2.11904
	FEMALE	88	34.5977	2.19623

	GENDER	N	Mean	Std. Deviation
Systolic Blood Pressure	MALE	112	146.8214	6.28772
	FEMALE	88	146.0909	5.19867
Diastolic Blood Pressure	MALE	112	91.9107	3.86612
	FEMALE	88	89.8977	3.26964

Table 3. provides descriptive statistics for several health parameters, including Body Mass Index (BMI), Waist Circumference, Waist-Hip Ratio (WHR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), analyzed separately for male (n=112) and female (n=88) participants. The data reveals gender-based differences in body composition and physiological measures. Females had a higher mean BMI (26.258) compared to males (24.732), whereas males exhibited greater WHR (0.9321) and waist circumference (37.5893 inches) than females, who had mean values of 0.8171 and 34.5977 inches, respectively. In terms of blood pressure, the mean SBP was similar between genders, with males at 146.82 mmHg and females at 146.09 mmHg. However, males had a slightly higher mean DBP (91.91 mmHg) than females (89.90 mmHg). These findings highlight notable gender disparities in certain parameters like BMI, WHR, and waist circumference, while blood pressure remained relatively comparable, suggesting nuanced variations in health risks between males and females.

Table 4 Inferential Statistics using independent t-test of Body Mass Index, Waist Circumference, Waist-Hip Ratio, Hypertension Male and Female

Variable	t	df	Sig. (2-tailed)	Mean Difference
BMI	4.827**	198	.000	-1.53474
WHR	29.72**	198	.000	0.11494
Waist Circumference	9.753**	198	.000	2.99156
Systolic Blood Pressure	0.879	198	.380	0.73052
Diastolic Blood Pressure	3.908**	198	.000	2.01299

***Significant at 0.01 Level*

The table 4 summarizes the results of independent samples t-tests on various health parameters between male and female participants, and the results of independent samples t-tests were used to assess the differences between the two groups. For **Body Mass Index (BMI)**, females had a higher mean (26.26) compared to males (24.72), and this difference was statistically significant ($t = -4.827$, $df = 198$, $p < .001$). In the case of the **Waist-to-Hip Ratio (WHR)**, males had a higher mean (0.9321) than females (0.8171), and this difference was also significant ($t = 29.728$, $df = 198$, $p < .001$).

For **Waist Circumference**, males had a larger mean (37.59 inches) compared to females (34.60 inches), and the difference was statistically significant ($t = 9.753$, $df = 198$, $p < .001$). In terms of **Systolic Blood Pressure**, males had a slightly higher mean (146.82 mmHg) than females (146.09 mmHg), but this difference was not statistically significant ($t = 0.879$, $df = 198$, $p = .380$). Similarly, for **Diastolic Blood Pressure**, males had a higher mean (91.91 mmHg) than females (89.90 mmHg), with a statistically significant difference ($t = 3.908$, $df = 198$, $p < .001$).

Part C: Comparative Analysis of Body Mass Index, Waist Circumference, Waist-Hip Ratio, Hypertension between Lucknow, Prayag Raj, Kanpur, and Jhansi Middle Age People of Uttar Pradesh.

Table 5 Descriptive Statistics of Body Mass Index, Waist Circumference, Waist-Hip Ratio, Hypertension & Diabetes among different cities of Uttar Pradesh

		N	Mean	Std. Deviation
BMI	LUCKNOW	50	25.2340	2.16188
	PRAYAG RAJ	50	26.2340	2.16188
	KANPUR	50	25.5000	2.51234
	JHANSI	50	24.6260	2.34040
	Total	200	25.3985	2.35356
WHR	LUCKNOW	50	.8808	.06271
	PRAYAG RAJ	50	.8870	.06343
	KANPUR	50	.8833	.06528
	JHANSI	50	.8748	.06298
	Total	200	.8815	.06328
Waist Circumference	LUCKNOW	50	36.1740	2.51573
	PRAYAG RAJ	50	36.8740	2.48027
	KANPUR	50	36.4700	2.81347
	JHANSI	50	35.5740	2.53448
	Total	200	36.2730	2.61335
Systolic Blood Pressure	LUCKNOW	50	146.3200	5.67645
	PRAYAG RAJ	50	147.6000	5.72855
	KANPUR	50	146.9600	5.94176
	JHANSI	50	145.1200	5.85763
	Total	200	146.5000	5.83095
Diastolic Blood Pressure	LUCKNOW	50	90.7600	3.41402
	PRAYAG RAJ	50	92.0400	3.68095
	KANPUR	50	91.5400	3.89772
	JHANSI	50	89.7600	3.67318
	Total	200	91.0250	3.74359

Table 5 presents data on various health parameters measured in participants from four locations: Lucknow, Prayag Raj, Kanpur, and Jhansi. For each location, 50 participants were assessed for Body Mass Index (BMI), Waist-to-Hip Ratio (WHR), Waist Circumference, Systolic and Diastolic Blood Pressure.

In terms of BMI, the mean values range from 24.63 in Jhansi to 26.23 in Prayag Raj, with an overall mean of 25.40. The standard deviation for BMI varies between 2.16 and 2.51, indicating moderate variability in BMI across the locations. For WHR, the mean values are relatively consistent, ranging from 0.8748 in Jhansi to 0.8870 in Prayag Raj, with a total mean of 0.8815. The standard deviation for WHR is between 0.0627 and 0.0653, showing minimal variation.

Waist Circumference shows a mean range from 35.57 cm in Jhansi to 36.87 cm in Prayag Raj, with an overall mean of 36.27 cm. The standard deviation for waist circumference ranges from 2.48 to 2.81 cm, suggesting some variation across the locations. Systolic blood pressure has a mean range from 145.12 mmHg in Jhansi to 147.60 mmHg in Prayag Raj, with an overall mean of 146.50 mmHg. The standard deviation for systolic blood pressure is fairly consistent across locations, ranging from 5.68 to 5.94 mmHg.

For Diastolic Blood Pressure, the mean values range from 89.76 mmHg in Jhansi to 92.04 mmHg in Prayag Raj, with a total mean of 91.03 mmHg. The standard deviation for diastolic blood pressure ranges from 3.41 to 3.90 mmHg, indicating slight variability.

Table 6 Analysis of Variances Between Different Cities Among Middle Age People of Uttar Pradesh.

		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
BMI	Between Groups	66.609	3	22.203	4.202**	.007
	Within Groups	1035.701	196	5.284		
	Total	1102.310	199			
WHR	Between Groups	.004	3	.001	.324	.808
	Within Groups	.793	196	.004		
	Total	.797	199			
Waist Circumference	Between Groups	44.921	3	14.974	2.233	.086
	Within Groups	1314.174	196	6.705		
	Total	1359.094	199			
Systolic Blood Pressure	Between Groups	167.920	3	55.973	1.663	.176
	Within Groups	6598.080	196	33.664		
	Total	6766.000	199			
Diastolic Blood Pressure	Between Groups	148.295	3	49.432	3.669*	.013
	Within Groups	2640.580	196	13.472		
	Total	2788.875	199			

**Significant at 0.05 Level*
***Significant at 0.01 Level*

Table 6 presents the results of an analysis of various health parameters (BMI, WHR, waist circumference, systolic and diastolic blood pressure) across four locations: Lucknow, Prayag Raj, Kanpur, and Jhansi, with 50 participants from each location.

For BMI, the results show a significant difference between groups ($F = 4.202$, $p = .007$), indicating that BMI varies across the locations. The mean BMI ranges from 24.63 in Jhansi to 26.23 in Prayag Raj, with an overall mean of 25.40 and a moderate standard deviation ranging from 2.16 to 2.51.

In contrast, the Waist-to-Hip Ratio (WHR) does not show significant differences ($F = 0.324$, $p = .808$), suggesting that WHR remains relatively consistent across the locations. The mean values range from 0.8748 in Jhansi to 0.8870 in Prayag Raj, with a total mean of 0.8815 and minimal variability in the standard deviation (between 0.0627 and 0.0653).

For waist circumference, there is a marginally significant difference ($F = 2.233$, $p = .086$), with a mean range from 35.57 cm in Jhansi to 36.87 cm in Prayag Raj, and an overall mean of 36.27 cm. The standard deviation ranges from 2.48 to 2.81 cm, indicating some variation.

Systolic blood pressure does not show significant group differences (F = 1.663, p = .176). The mean systolic blood pressure values range from 145.12 mmHg in Jhansi to 147.60 mmHg in Prayag Raj, with a total mean of 146.50 mmHg and fairly consistent standard deviations between 5.68 and 5.94 mmHg.

The diastolic blood pressure shows a significant difference between groups (F = 3.669, p = .013). The mean values range from 89.76 mmHg in Jhansi to 92.04 mmHg in Prayag Raj, with an overall mean of 91.03 mmHg. The standard deviation for diastolic blood pressure ranges from 3.41 to 3.90 mmHg, indicating slight variability.

Table 7 Post Hoc Test using Bonferroni Multiple Comparisons for BMI, Diastolic Blood Pressure, and Blood Sugar Level

Dependent Variable	(I) CITY	(J) CITY	Mean Difference (I-J)	Sig.
BMI	Lucknow	PRAYAG RAJ	-1.00000	0.185
		KANPUR	-0.26600	1.000
		JHANSI	0.60800	1.000
	PRAYAG RAJ	Lucknow	1.00000	0.185
		KANPUR	0.73400	0.672
		JHANSI	1.60800**	0.003
	KANPUR	Lucknow	0.26600	1.000
		PRAYAG RAJ	-0.73400	0.672
		JHANSI	0.87400	0.353
	JHANSI	Lucknow	-0.60800	1.000
		PRAYAG RAJ	-1.60800**	0.003
		KANPUR	-0.87400	0.353
Diastolic Blood Pressure	Lucknow	PRAYAG RAJ	-1.28000	0.497
		KANPUR	-0.78000	1.000
		JHANSI	1.00000	1.000
	PRAYAG RAJ	Lucknow	1.28000	0.497
		KANPUR	0.50000	1.000
		JHANSI	2.28000*	0.013
	KANPUR	Lucknow	0.78000	1.000
		PRAYAG RAJ	-0.50000	1.000
		JHANSI	1.78000	0.097
	JHANSI	Lucknow	-1.00000	1.000
		PRAYAG RAJ	-2.28000*	0.013
		KANPUR	-1.78000	0.097

**Significant at 0.05 Level*
***Significant at 0.01 Level*

Table 7 presents the results of a Post Hoc Test using Bonferroni multiple comparisons for three health parameters: BMI and diastolic Blood Pressure comparing data across four cities: Lucknow, Prayag Raj, Kanpur, and Jhansi. The analysis reveals significant differences in BMI and diastolic Blood Pressure Levels between specific city pairs.

For **BMI**, a significant difference was found between Prayag Raj and Jhansi (mean difference = 1.608, p = 0.003), with Jhansi showing a higher BMI than Prayag Raj.

However, no significant differences were observed between other city pairs, such as Lucknow vs Prayag Raj, Lucknow vs Kanpur, and Kanpur vs Jhansi.

In the case of **Diastolic Blood Pressure**, a significant difference was noted between Prayag Raj and Jhansi (mean difference = 2.280, p = 0.013), indicating that Diastolic Blood Pressure in Jhansi was significantly higher than in Prayag Raj. No significant differences were found in the other city comparisons, including Lucknow vs Kanpur and Kanpur vs Jhansi.

In summary, the Bonferroni multiple comparisons indicated significant differences in BMI, Diastolic Blood Pressure, and Levels primarily between Prayag Raj and Jhansi. For the other city pairs, no statistically significant differences were observed.

DISCUSSION AND FINDINGS OF THE STUDY

From Part A

This study investigates the relationship between anthropometric measures—Body Mass Index (BMI), Waist Circumference (WC), and Waist-Hip Ratio (WHR)—with hypertension among middle-aged individuals in Uttar Pradesh. The findings provide valuable insights into the predictive role of these anthropometric variables for hypertension in the studied population.

Relationship between Anthropometric Measures and Hypertension

The results in **Table 1** indicate a significant positive correlation between BMI, WHR, Waist Circumference, and both systolic and diastolic blood pressure, with all correlations being statistically significant at the 0.01 level. Specifically, BMI showed moderate correlations with both systolic (r = 0.417) and diastolic (r = 0.373) blood pressure, suggesting that higher BMI is associated with higher blood pressure levels. These findings align with previous studies that have reported BMI as a significant risk factor for hypertension (Koh et al., 2020; Picon et al., 2018).

WHR, although exhibiting a weaker correlation with systolic blood pressure (r = 0.308), demonstrated a stronger correlation with diastolic blood pressure (r = 0.487). These results are consistent with literature suggesting that central obesity, as measured by WHR, has a stronger association with hypertension, especially with diastolic blood pressure (Aroor et al., 2017; Kaur, 2018). Waist Circumference, with the highest correlations (r = 0.489 for systolic and r = 0.501 for diastolic), emerges as the most robust predictor of hypertension among the variables studied. This is in line with the findings by Gu et al. (2020), who noted that WC is a more reliable indicator of hypertension risk compared to other anthropometric measures like BMI and WHR.

From Part B

The present study aimed to investigate the gender-based differences in key health parameters among middle-aged individuals from Uttar Pradesh. The health parameters examined included Body Mass Index (BMI), Waist-to-Hip Ratio (WHR), waist circumference, and systolic and diastolic blood pressure. The findings reveal several significant gender-based differences, with males generally exhibiting higher values in some parameters, while females demonstrated higher BMI values.

Body Mass Index (BMI)

The results of this study indicate a significant difference in BMI between males and females, with females having a higher average BMI (26.26) compared to males (24.72). This difference was found to be statistically significant ($t = -4.827$, $p < .001$). The higher BMI in females aligns with findings from previous studies that suggest women, especially in middle age, tend to accumulate more body fat, particularly in the abdominal region (Khosla et al., 2016; Singh et al., 2021). This may be attributed to hormonal changes during menopause, which are known to affect fat distribution and overall body composition (Taveras et al., 2017).

Waist-to-Hip Ratio (WHR)

In terms of WHR, males had a significantly higher mean (0.9321) compared to females (0.8171), with a statistically significant difference ($t = 29.728$, $p < .001$). This finding supports earlier studies suggesting that males typically carry more visceral fat around their abdominal area, which results in a higher WHR (Zhao et al., 2019). A higher WHR is often associated with an increased risk of cardiovascular diseases and metabolic disorders (Chung et al., 2020). Thus, the higher WHR in males may signal a greater risk for health complications linked to obesity.

Waist Circumference

The study also revealed a statistically significant difference in waist circumference, with males exhibiting a larger average circumference (37.59 inches) compared to females (34.60 inches) ($t = 9.753$, $p < .001$). This finding is consistent with previous research that demonstrates men tend to have greater central adiposity, which is strongly associated with metabolic risk factors like hypertension, diabetes, and cardiovascular diseases (Batrakoulis et al., 2021). The larger waist circumference in males suggests that abdominal obesity could be a more prominent health concern for them.

Systolic and Diastolic Blood Pressure

The systolic blood pressure was higher in males (146.82 mmHg) than females (146.09 mmHg), though the difference was not statistically significant ($t = 0.879$, $p = .380$). However, males exhibited a significantly higher diastolic blood pressure (91.91 mmHg) than females (89.90 mmHg), with the difference being statistically significant ($t = 3.908$, $p < .001$). These findings are in line with literature suggesting that men are more likely to experience higher blood pressure levels, particularly diastolic pressure, as they age (Kearney et al., 2020). Elevated diastolic blood pressure in males can be an indicator of potential cardiovascular issues, which may require targeted interventions (Tsioufis et al., 2018).

From Part C

The present study aimed to compare various health parameters, including Body Mass Index (BMI), Waist Circumference, Waist-to-Hip Ratio (WHR), and blood pressure among middle-aged individuals from four cities in Uttar Pradesh: Lucknow, Prayag Raj, Kanpur, and Jhansi. The findings of this study provide valuable insights into the health status of people from different urban regions in Uttar Pradesh.

Body Mass Index (BMI)

The analysis revealed significant differences in BMI across the four cities ($F = 4.202$, $p = 0.007$), with Prayag Raj exhibiting the highest mean BMI (26.23) and Jhansi the lowest (24.63). The Bonferroni post hoc test indicated that BMI in Jhansi was significantly lower than in Prayag Raj (mean difference = 1.608, p = 0.003), suggesting regional variations in weight status. This could be due to differences in lifestyle, dietary habits, or physical activity levels across the regions. These results are consistent with previous studies which have shown that urbanization is often associated with higher BMI due to changes in diet and reduced physical activity (Sahoo et al., 2015; Gopalan et al., 2018).

Waist-to-Hip Ratio (WHR)

In contrast to BMI, WHR did not show any significant differences between the cities (F = 0.324, p = 0.808). The mean WHR values across the cities ranged from 0.8748 in Jhansi to 0.8870 in Prayag Raj, which suggests that the distribution of fat around the waist and hips remains relatively consistent across these locations. This is in line with findings from other studies, where WHR, being more related to body fat distribution than to overall obesity, tends to be less influenced by regional factors than BMI (Ashwell et al., 2012).

Waist Circumference

The analysis of waist circumference revealed a marginally significant difference between cities (F = 2.233, p = 0.086). Although the differences did not reach conventional significance, variations in mean waist circumference were noted, with Prayag Raj having the largest mean waist circumference (36.87 cm) and Jhansi the smallest (35.57 cm). This suggests regional variations in abdominal obesity, a known risk factor for cardiovascular diseases (Moran et al., 2013). However, the lack of statistical significance suggests that waist circumference might be influenced by other factors not captured in the study.

Systolic and Diastolic Blood Pressure

Systolic blood pressure did not show significant differences across the cities (F = 1.663, p = 0.176), indicating that blood pressure levels were relatively similar across the four cities. However, diastolic blood pressure demonstrated significant variability (F = 3.669, p = 0.013), with Prayag Raj having lower diastolic pressure compared to Jhansi (mean difference = 2.280, p = 0.013). This could suggest differences in lifestyle factors such as diet, stress levels, or healthcare access between the cities, which may influence blood pressure regulation. Similar findings have been reported in studies examining the impact of urban and rural living on hypertension (Chobanian et al., 2003).

CONCLUSION

In conclusion, this study highlights the significant relationships between BMI, Waist Circumference, WHR, and hypertension among middle-aged individuals. Waist Circumference, in particular, emerged as a strong predictor of both hypertension, reinforcing the importance of central obesity as a key factor in cardiovascular and metabolic health. These findings suggest that interventions targeting weight management and reducing central obesity may be critical in managing and preventing hypertension in this population.

The findings from this study provide valuable insights into the gender-based differences in key health parameters among middle-aged individuals in Uttar Pradesh. The study highlights that while males generally have higher values in waist circumference, WHR, and blood pressure, females have a higher BMI. These results underscore the importance of considering gender-specific health risks, particularly about obesity and cardiovascular diseases. Further research is needed to explore the underlying factors contributing to these gender differences and to develop targeted health interventions.

The study highlighted significant regional differences in BMI, and diastolic blood pressure, particularly between Prayag Raj and Jhansi. The findings suggest that urban and rural living conditions may contribute to variations in health outcomes. However, no significant differences were observed in WHR and systolic blood pressure across the cities. These findings are consistent with existing literature on regional health disparities and underline the need for targeted public health interventions to address these variations (Bhattacharya et al., 2018; Singh et al., 2021).

Summary

This research study investigates the relationship between key anthropometric measures—**Body Mass Index (BMI)**, **Waist Circumference (WC)**, and **Waist-Hip Ratio (WHR)**—with **hypertension**, among middle-aged individuals in the state of **Uttar Pradesh**. The primary aim was to explore how these body measurements are associated with the risk of developing hypertension (high blood pressure). The study also aimed to assess the gender-based differences and regional disparities in these health parameters, across four cities in Uttar Pradesh: **Lucknow**, **Prayag Raj**, **Kanpur**, and **Jhansi**.

The findings revealed significant positive correlations between the anthropometric measures and systolic and diastolic blood pressure (the two components of hypertension). Among the variables, **Waist Circumference (WC)** stood out as the most consistent and strong predictor of hypertension, especially for both systolic and diastolic blood pressure. **Waist-hip ratio (WHR)** and **Body Mass Index (BMI)** also showed significant associations with these health conditions, although to a slightly lesser extent.

In terms of gender-based differences, males generally exhibited higher values in **Waist Circumference** and **Waist-Hip Ratio**, while females showed a higher **Body Mass Index**. Blood pressure measurements were also higher in males compared to females, with diastolic blood pressure being significantly higher in males. As for the regional differences, significant variations in **BMI** &**blood pressure** were noted between the cities, with individuals from **Prayag Raj** exhibiting the highest BMI.

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Conflict of Interest

The author(s) declared no conflict of interest.

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