



Prevalence and risk factors of hypertension in urban and rural populations of Vadodara, Gujarat

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Abstract. Hypertension, one of the most common non-communicable diseases, is associated with various modifiable risk factors. This study was carried out to compare the prevalence and risk factors of hypertension in urban and rural populations above 30 years of age. An OPD-based cross-sectional study was conducted at the Urban Health Training Centre (UHTC) and Rural Health Training Centre (RHTC) of the Medical College, affiliated to a tertiary care hospital, from May to July 2023, enrolling 100 participants each from UHTC and RHTC, aged more than 30 years. Using a pre-tested questionnaire, socio-demographic, personal and family details, lifestyle risk factors, blood pressure and anthropometric measurements were taken. The proportion of hypertensive patients was 41% in urban and 27% in rural (z-value: 2.11, p-value: <0.05), of which more than half were males in both urban (58%) and rural (59%). A major proportion of hypertensive patients was found in the age group of above 70 years in both urban (10 out of 12

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participants) and rural populations (7 out of 10 participants). Out of the diagnosed cases, 90% of urban and 70% of rural patients were on regular medication. Family history of hypertension (z-value: 3.43, p-value: <0.05), diabetes (z-value: 2.73, p-value: <0.05) and lifestyle risk factors like lack of physical activity (z-value: 2.93, p-value: <0.05), and stress (z-value: 3.39, p-value: <0.05) were significantly higher in urban areas, whereas smokeless tobacco consumption (z-value: 4, p-value: <0.05) and high salt diet (z-value: 3.37, p-value: <0.05) were significantly higher in rural areas. This study provides insights into how different environmental factors and cultural differences affect prevalence and risk factors associated with hypertension and helps in targeted public health interventions. The result will contribute to a better understanding of how environmental and cultural factors influence hypertension in a rapidly industrialising state, offering insights that can guide public health policies and more targeted interventions aimed at reducing the burden of hypertension in both settings in Gujarat

Keywords: non-communicable diseases; blood pressure; lifestyle disorder; proportion; urbanisation; comparison

Introduction

Hypertension (high blood pressure), one among the most common Non-Communicable Diseases (NCDs), stands out as a leading cause of death, earning the moniker of the “silent killer” as it contributes to cardiovascular diseases, stroke, chronic kidney disease, and other severe complications [1, 2]. The World Health Organization’s (WHO) global report on hypertension 2023 [3] highlights the global prevalence of hypertension as 33% (34% in males and 32% in females), that has estimated to cause 7.5 million deaths worldwide annually [4]. According to a study done by S.F. Koya *et al.* [5], hypertension awareness and control are alarmingly low in many regions in India, despite its increasing prevalence due to urbanisation and lifestyle shifts.

A.E. Schutte *et al.* [6] similarly reported that in low- and middle-income countries, the management of hypertension is lagging behind global standards, contributing to rising mortality rates. One of the primary unresolved issues is the urban-rural disparity in hypertension prevalence, particularly in rapidly urbanising regions. C. Ricci *et al.* [7] have provided essential insights into how hypertension contributes to all-cause and cause-specific mortality. The study by C. Ke *et al.* [8] revealed that hypertension increases the odds of cardiovascular deaths due to ischemic heart disease (IHD) and stroke, by six- to eight-fold, and that the mortality burden is growing more rapidly in rural areas. The study by R. Mohammad & D.W. Bansod [9] showed that there was a higher prevalence of hypertension among men compared to women with a higher proportion in urban residents and the prevalence increased with age. H. Song *et al.* [10] highlighted the urban-rural disparity in the prevalence of factors influencing hypertension such as age, gender, occupation, literacy, dietary habits, diabetic status, high BMI, lack of physical activity, alcohol and tobacco consumption. J. Pan *et al.* [11] emphasised the differences in the adherence to treatment in hypertensive patients of urban and rural areas, with a significantly lower adherence in the rural areas compared to urban settings. Despite the extensive research on hypertension, there remains a gap in studies focusing on local popular dynamics within India, particularly in states like Gujarat. Vadodara district, which exemplifies a coexistence of urban and rural population, presents an ideal microcosm to investigate these differences.

This study aimed to fill the gap by investigating the proportion of hypertension and risk factors such as age, gender, obesity, tobacco use, physical inactivity, high salt intake, and alcohol consumption, which have been consistently associated with hypertension across different settings, in urban and rural population of age more than 30 years in Vadodara district of Gujarat.

Materials and Methods

An OPD based cross-sectional study was conducted at Urban Health Training Centre (UHTC) and Rural Health Training Centre (RHTC) of Medical College affiliated to tertiary care hospital. UHTC is situated at a locality in Vadodara city which covers around 56,000 population. RHTC is situated at a village near the outskirts of Vadodara city and covered a population of around 37,000. A total of 200 participants were enrolled through purposive sampling, 100 each from UHTC and RHTC of age more than 30 years from May to July, 2023. Pregnant women and those individuals not willing to participate were excluded from the study.

This study adhered to the Code of Ethics of the American Sociological Association [12] and appropriate permission was obtained from the Medical Officer in-charge of RHTC and UHTC to conduct the study by explaining its purpose and outcome. After taking informed consent from the willing participants by explaining nature of the study and guaranteeing anonymity, a pretested questionnaire was used to gather data on socio-demographic characteristics including age, gender, education, occupation, family history of hypertension, and collected information on lifestyle risk factors such as consumption of alcohol and tobacco products, excessive salt intake, and lack of physical exercise.

Operational definitions: A person is found to have family history of hypertension if one or both parents had the condition. Males were classified as heavy drinkers if they consume more than two alcoholic drinks per day and females were considered as heavy drinkers if they consume more than one drink per day [13]. A person was defined as a smoker if they currently smoke any form of tobacco including cigarette, beedi, or cigar. Smokeless tobacco use includes consumption of products like pan, gutka, tobacco-lime mixtures or any other form of tobacco. Regular exercise was described as engaging in physical activity for at least 30

minutes per day, a minimum of 5 days per week [14]. Excessive salt intake refers to consuming more than 6 grams of sodium chloride per day. Adequate sleep was characterised by having quality sleep for 7 hours or more [15].

Blood pressure (BP) was measured in the right arm using mercury sphygmomanometer (Diamond, manufactured in India) in sitting position after 5-10 minutes of rest and no immediate intake of hot drinks like tea or coffee within last 30 minutes. Electronic weighing machine (Electronic Personal Scale SCS-0180, manufactured in China) was used to record the weight. Height was measured using a measuring tape fixed to the wall while the subject stood on a level surface with heels together, barefoot. Waist circumference was taken with the subject standing upright, using a non-elastic plastic tape positioned midway between the lower rib margin and the iliac crest, ensuring the tape was pulled snug but not pressing into the skin. Waist circumference risk classification was done according to the WHO criteria [16], waist circumference ≥ 94 cm was considered to be increased risk category in males and waist circumference ≥ 80 cm was considered to be increased risk category in females. Body mass index (BMI) was calculated and classified according to standard WHO criteria [17]. Those with BMI ≥ 25 kg/m² was considered to be high risk group for hypertension.

The Joint National Committee 7 (JNC-7) criteria [18] was used for the definition and classification of hypertension. According to that, hypertension was defined as having a systolic blood pressure of 140 mmHg or higher and/or a diastolic blood pressure of 90 mmHg or higher, those individuals having BP under this category were reassessed and

average of three readings were taken. Already diagnosed cases were counted and first time diagnosed cases were asked to come for follow up and further management.

Quantitative data was expressed in mean (\pm Standard Deviation). Proportion of hypertension and prevalence of risk factors in urban and rural population were expressed in percentages. Data entry and analysis was done using Microsoft Excel Version 2408. Standard Error of Difference between two proportions was used to examine the differences in proportion of hypertension and identifying significant difference in prevalence of risk factors within each population subgroups. P-value < 0.05 was considered to be significant.

Results and Discussion

A total of 200 participants were enrolled in the study, 100 each from urban and rural areas with a mean (\pm Standard Deviation) age of 54.1 (± 12.3) years in urban and 51 (± 12.1) years in rural. More than half of the study population were males (53%) in urban whereas more than half were females (52%) in the rural population. Higher proportion of hypertensive patients were males in both urban (58%) and rural (59%) areas. Considering the age distribution, maximum number of participants belonged to the age group 50-59 years in urban and 40-49 years in rural while proportion of hypertensive patients was more in the age group of above 70 years in both urban (10 out of 12 participants) and rural population (7 out of 10 participants). Seven percent of the total hypertensives in urban and 4% in rural were young hypertensives. Socio-demographic distribution of the participants is shown in Table 1.

Table 1. Socio-demographic distribution of the participants in urban and rural population

Gender	Gender distribution of the study participants					
	Urban			Rural		
	n	Hypertensive n	%	n	Hypertensive n	%
Males	53	24	45	48	16	33
Females	47	17	36	52	11	21
Age (in years)	Age distribution of the study participants					
	Urban			Rural		
	n	Hypertensive n	%	n	Hypertensive n	%
30-39	14	3	21	20	1	5
40-49	20	6	30	29	2	7
50-59	31	10	32	19	9	47
60-69	23	12	52	22	8	36
>70	12	10	83	10	7	70
Total	100	41	41	100	27	27

Notes: n = 100, therefore n is same as proportion

Source: compiled by the authors

The total proportion of hypertensive patients was found to be 34%, with 41% in urban and 27% in rural population and this difference was found to be statistically significant (z-value: 2.11, p-value: < 0.05). Only 16% in urban and 21% in rural population were normotensives and a large proportion of

study participants in both urban (52%) and rural (49%) were pre-hypertensives according to JNC-7 classification (Table 2). There were 6 and 8 patients from the urban and rural area, respectively, who were diagnosed first time as hypertensive and asked to come for follow up and further management.

Table 2. Classification of the participants according to JNC-7 classification

Blood pressure classification	Total		Urban		Rural	
	n	%	n	%	n	%
Normotensive	37	18.5	16	16	21	21
Pre hypertensive	101	50.5	52	52	49	49
Hypertension – stage I	40	20	21	21	19	19
Hypertension – stage II	22	11	11	11	11	11
Total	200		100		100	

Source: compiled by the authors

In urban area, out of the total hypertensives, 90% of the patients were on regular medication while the remaining 10% did not take medicines regularly. 80% of the patients were taking medicines from government sources and the rest were taking medicines from private sources and majority (75%) of the patients on irregular medication were taking medicines from private sources. In the rural area, only 70% of the total hypertensives were on regular medication and the rest were on irregular medication. 89% of the patients were taking medicines from government sources and only 11% of the patients were taking from private sources. This difference in the medication adherence in urban and rural population was found to be statistically significant (z-value: 3.64, p-value: <0.05).

Lack of physical activity (z-value: 2.93, p-value: <0.05), family history of hypertension (z-value: 3.43, p-value:

<0.05), prevalence of diabetes (z-value: 2.73, p-value: <0.05) and stress (z-value: 3.39, p-value: <0.05) were significantly higher in urban areas compared to rural areas whereas smokeless tobacco consumption (z-value: 4, p-value: <0.05) and high salt diet (z-value: 3.37, p-value: <0.05) were significantly higher in rural areas (Table 3). The prevalence of major risk factors of hypertension given by the Centres of Disease Control and Prevention including high salt intake, lack of physical activity, alcohol and tobacco use, obesity, family history of hypertension and diabetic status were determined and in addition to that, stress and lack of good sleep (sleep <7 hours/day) [15] were also assessed and given in Figure 1, which shows a high prevalence of over-weight/obesity (BMI ≥ 25 kg/m²), high risk waist circumference and consumption of tobacco products in both the areas.

Table 3. Assessing the differences in the proportion of risk factors by Standard Error of Difference between two Proportions

Risk factors	Urban		Rural		z-value	p-value
	n (%)	95% CI	n (%)	95% CI		
Tobacco smoking	39	(29.40-49.27)	27	(18.61-36.80)	1.82	>0.05
Smokeless tobacco consumption	30	(21.24-39.98)	57	(46.71-66.86)	4	<0.05
Alcohol consumption	6	(2.23-12.60)	9	(4.20-16.40)	0.81	>0.05
Family history of hypertension	53	(46.27-65.73)	30	(21.24-39.98)	3.43	<0.05
Lack of physical activity (<30 min/day)	77	(67.51-84.83)	58	(47.71-67.80)	2.93	<0.05
High salt diet	45	(35.03-55.27)	68	(57.92-76.98)	3.37	<0.05
BMI ≥ 25 kg/m ²	52	(41.78-62.10)	43	(33.14-53.29)	0.95	>0.05
Waist circumference (males ≥ 94 cm & females ≥ 80 cm)	52	(41.78-62.10)	41	(31.26-51.29)	1.56	>0.05
History of DM	43	(33.14-53.29)	25	(16.88-34.66)	2.73	<0.05
Stress	70	(60.02-78.76)	47	(36.94-57.24)	3.39	<0.05
Inadequate sleep (<7 hours)	36	(26.64-46.21)	26	(17.74-35.73)	1.54	>0.05

Notes: p-value <0.05 is considered to be significant

Source: compiled by the authors

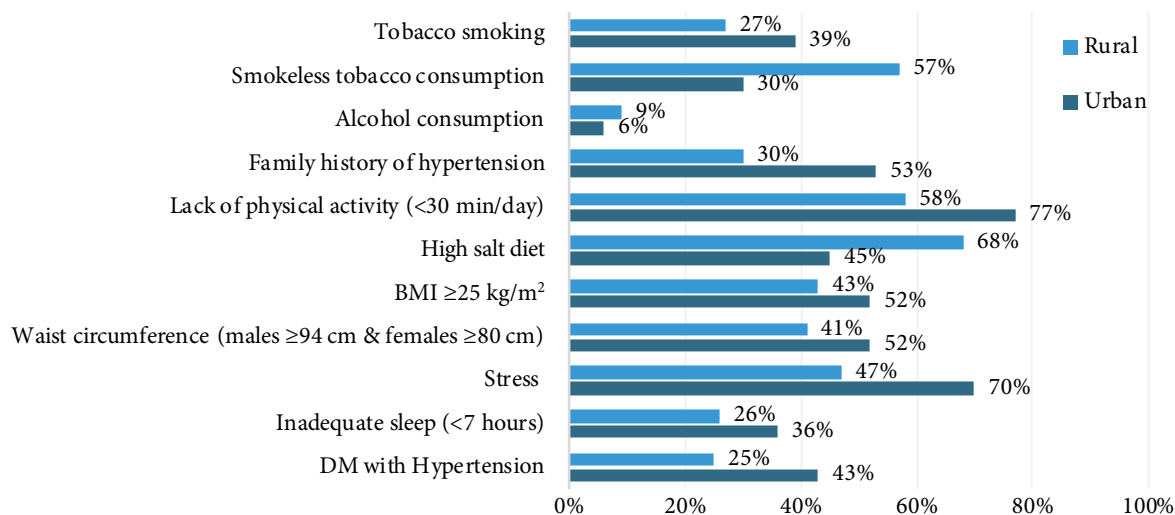


Figure 1. Prevalence of risk factors in urban and rural population

Source: compiled by the authors

This study highlights the burden of hypertension in the urban and rural field practice area. The proportion of hypertension, according to JNC-7 criteria, was found to be 34% which aligns with the estimates given by WHO Global Report on hypertension [3] which was 33%. In addition, this study revealed significant differences between urban and rural populations, even though overall prevalence was higher in urban areas (41%), rural areas still had a substantial burden (27%). These findings were comparable with the findings of a study by I.M. Ismail *et al.* [19], who reported a higher prevalence of hypertension among urban residents (23.7%) compared to rural dwellers (18.3%) in coastal regions of South India. The study by R. Anchala *et al.* [20] found a higher prevalence of hypertension in urban areas (33.8%) compared to rural areas (27.6%), which often shows higher hypertension rates due to urbanisation and life style changes. Similarly, the Office of Registrar General of India [21] also shows a higher prevalence in urban areas (25%) compared to rural areas (10%). This difference in proportion could be conditioned by dietary habits, physical activity, and increased stress levels in cities as per this study.

Present study identified that more than half of the hypertensive patients in both urban (58%) and rural (59%) areas were males, which was comparable to a study by U. Venkatesh *et al.* [22], where the prevalence of hypertension was found higher in males (18.2%) than in females (16.1%). Similar trend was found in a study by S. Singh *et al.* [23] in urban Varanasi, where the prevalence of hypertension was 40.9% in males and 26% in females. This gender disparity needs further evaluations and it could be due to the difference in occupational stress, addictions, and lifestyle choices. Knowledge about these gender specific variations will be helpful in targeted interventions and prevention.

Major proportion of hypertensive patients were in the age group of above 70 years followed by 60 to 69 years in both the areas which was found similar to the study by Y. Osthega *et al.* [24] that showed 74.5% of older adults over 60 years of age have hypertension. Another study by

E. Oliveros *et al.* [25] found that 65% of men and 75% of women were found to develop hypertension by the age of 70 years. These findings suggest that age is a well-established risk factor for hypertension and as age increases, the risk of hypertension also increases, leading to a decline in cardiovascular endurance as indicated by a study done by S. Vadzyuk & P. Tabas [26]. This study also identified a small proportion (7% in urban and 4% in rural) of young hypertensives (30-39 years) while a study by Z. Geevar *et al.* [27] in Kerala have found the prevalence of hypertension among young adults as 11.2% which is higher than the findings of this study. This emphasises the need of early detection and management across all age groups.

A notable finding was the presence of undiagnosed hypertensive cases. 6 (6%) participants in urban and 8 (8%) participants in rural population had elevated blood pressure (>140/90 mmHg) but were not previously diagnosed. This trend was found similar to a study by B. Boro & S. Banerjee [28] in which the prevalence of undiagnosed cases was found higher in rural areas than in urban areas, while, a study conducted by P.D. Appadurai *et al.* [29] in South Indian districts found that the proportion of undiagnosed hypertensive cases were more in urban than in rural. Those cases were encouraged to seek follow up care to prevent complication and reduce the burden of hypertension related morbidity. This shows that the government initiative proposed for screening of hypertension and diabetes in all participants above the age of 30 years may indeed help in early identification of these non-communicable disease and manage them timely.

Among the diagnosed cases, medication adherence was significantly higher in the urban population (90%) than in the rural population (70%) which was comparable with a study by P.R. Katapadi & D.D. Bant [30] in which the antihypertensive adherence was more in urban (76%) than in rural (71%), and a study by D. Mathur *et al.* [31] in Rajasthan found that the proportion of non-adherent patients were more in rural (39.7%) than in urban (14.4%)

population. This difference could be due to better access to health care facilities in urban and higher health seeking behaviour of the urban population. This discrepancy demands health promotion and counselling in the rural areas to improve medication adherence. A qualitative insight to look into these perceptions is warranted.

Considering the major risk factors of hypertension, the present study identified that lack of physical activity, family history of hypertension, prevalence of diabetes and stress were significantly higher in urban areas as compared to rural areas while smokeless tobacco consumption and high salt diet were significantly higher in rural areas. A similar study by R.R. Marinayakanakoppalu & A.C. Nagaralu [32] found that there was a statistically significant difference in the proportion of individuals having extra salt intake, family history of hypertension, overweight and obesity in urban and rural population of India. This disparity highlights the impact of lifestyle in urban areas while cultural habits and lack of awareness regarding the disease in rural settings.

These findings signify the comparable difference in the burden of hypertension and its associated risk factors in urban and rural settings across various parts of the country. Similar difference was observed in the medication adherence, with a lower medication adherence in the rural areas adding to the disease associated mortality. This emphasises the critical need for comprehensive public health strategies to address hypertension and its prevailing risk factors in different contexts.

Conclusions

This study highlights a significant difference in the prevalence and risk factors of hypertension between urban and rural population. Urban areas showed a higher prevalence of hypertension (41%) compared to rural areas (27%), and this difference was found to be statistically significant. Proportion of male and female participants were comparable in both urban and rural settings, with higher rates of hypertension in males than in females in both the settings. Hypertension was more prevalent among older age group,

particularly those above 70 years, in both urban and rural population, with about half of the participants having pre-hypertension in both the areas. Medication adherence was found better in urban areas, with 90% of hypertensive patients taking regular medications, compared to only 70% in rural areas. This disparity underscores the importance of improving health care access and health seeking behaviour in rural settings. Risk factors such as lack of physical activity, family history of hypertension, diabetes, and stress were significantly higher in the urban areas, reflecting the lifestyle and environmental factors associated with urbanisation. In contrast, rural participants showed higher rates of smokeless tobacco consumption and a high salt diet compared to urban areas, while other risk factors were equally prevailing in both the areas. Identifying the risk factors for hypertension and tracking of participants with these risk factors may help in early diagnosis and thereby prevent complications. Targeted interventions should be done by tailoring public health efforts to the specific needs of urban and rural population and the strategies should address risk factors prevalent in each setting. Further research into role of socio-economic, cultural and health care access factors is required to be conducted in both the settings, for a better understanding of the urban-rural disparities in the prevalence and associated risk factors of hypertension.

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Conflict of Interest

None.

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Поширеність та фактори ризику артеріальної гіпертензії серед міського та сільського населення Ваходари, штат Гуджарат

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Анотація. Артеріальна гіпертензія, одне з найпоширеніших неінфекційних захворювань, асоціюється з різними модифікованими факторами ризику. Це дослідження було проведено з метою порівняння поширеності та факторів ризику артеріальної гіпертензії серед міського та сільського населення старше 30 років. Перехресне дослідження за участю амбулаторних пацієнтів було проведено в Міському навчальному центрі охорони здоров'я (МНЦОЗ) та Сільському навчальному центрі охорони здоров'я (СНЦОЗ) Медичного коледжу при лікарні третинного рівня з травня по липень 2023 року, в якому взяли участь по 100 осіб з МНЦОЗ та СНЦОЗ у віці понад 30 років. За допомогою попередньо протестованої анкети було зібрано соціально-демографічні, особисті та сімейні дані, фактори ризику способу життя, виміряно артеріальний тиск та антропометричні показники. Частка пацієнтів з артеріальною гіпертензією становила 41 % у містах і 27 % у сільській місцевості (z-значення: 2,11, p-значення: <0,05), з яких більше половини були чоловіками як у містах (58 %), так і в сільській місцевості (59 %). Найбільша частка пацієнтів з артеріальною гіпертензією була виявлена у віковій групі старше 70 років, як серед міського (10 з 12 учасників), так і серед сільського населення (7 з 10 учасників). Серед діагностованих випадків 90 % міських і 70 % сільських пацієнтів регулярно приймали ліки. Сімейний анамнез артеріальної гіпертензії (z-значення: 3,43, p-значення: <0,05), діабету (z-значення: 2,73, p-значення: <0,05) та фактори ризику, пов'язані зі способом життя, такі як недостатня фізична активність (z-значення: 2,93, p-значення: <0,05) та стрес (z-значення: 3,39, p-значення: <0,05) були значно вищими в міській місцевості, тоді як споживання некурального тютюну (z-значення: 4, p-значення: <0,05) та дієта з високим вмістом солі (z-значення: 3,37, p-значення: <0,05) були значно вищими в сільській місцевості. Це дослідження дає уявлення про те, як різні фактори навколишнього середовища та культурні відмінності впливають на поширеність і фактори ризику, пов'язані з гіпертонією, і допомагає в розробці цілеспрямованих заходів у сфері охорони здоров'я. Результати дослідження сприятимуть кращому розумінню того, як екологічні та культурні фактори впливають на артеріальну гіпертензію у швидко індустріалізованому штаті, пропонуючи ідеї, які можуть спрямовувати політику громадського здоров'я та більш цілеспрямовані втручання, спрямовані на зменшення захворюваності на артеріальну гіпертензію в обох середовищах у штаті Гуджарат

Ключові слова: неінфекційні захворювання; артеріальний тиск; порушення способу життя; частка; урбанізація; порівняння