

# Urban-rural differential in Hypertension and Diabetes among Elderly in India: A study of prevalence, factors, and treatment-seeking

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## Research Article

**Keywords:** Hypertension, Diabetes, Urban-rural differential, Treatment-seeking, India

**Posted Date:** May 4th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-488657/v1>

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# Abstract

**Objectives:** The study estimates the prevalence of hypertension and diabetes among older adults and bring forth the urban-rural differentials in the said morbidities. The treatment-seeking approach of older adults is also looked at with regard to hypertension and diabetes.

**Methods:** The data for this study come from the Longitudinal Ageing Study in India (LASI) conducted in 2017-18. Bivariate analyses were used to understand the rural-urban gap in hypertension and diabetes with socioeconomic and demographic parameters. Further, logistic regression was used to check the likelihood of hypertension and diabetes with socioeconomic and demographic variables. Finally, a non-linear decomposition technique, Fairlie's decomposition technique was applied to check the difference in the probability of hypertension and diabetes between rural and urban by estimating contributions of a group (rural-urban) differences.

**Results:** Study noted a higher prevalence of hypertension and diabetes among elderly residing in urban areas than their counterparts. Prevalence of hypertension and diabetes was higher among those aged 70+, elderly females, less educated, and non-poor. Education status alone accounts for more than four-fifths (88.62%) and more than half (52.02%) of the inequality in the prevalence of urban-rural hypertension and diabetes, respectively. Elderly with higher education were 2.88 times (OR=2.88; C.I.= 1.40-5.90) more likely to sought treatment for hypertension than uneducated older people in urban areas

**Conclusion:** Since treatment-seeking is relatively low among elderly in poor households, practices must be identified for a poverty-stricken elderly population to overcome the financial barriers that may prevent the elderly from seeking and complying with treatment.

## 1. Introduction

Globally, non-communicable diseases (NCDs) cause the death of nearly 41 million people every year, equivalent to 71% of the total deaths (GBD 2015). Cardiovascular diseases account for most NCD deaths (17.9 million), followed by cancer, respiratory diseases, and diabetes (1.5 million) [1]. Hypertension is routinely associated with developing various cardiovascular diseases such as ischemic heart disease, heart failure, strokes, etc. [2–3]. The Global Burden of Disease (2015) listed hypertension as one of the top causes of not only mortality but also for loss of disability-adjusted life years [1]. Similarly, diabetes is also a risk factor for cardiovascular disease. Both hypertension and diabetes are often prevalent among older adults as both these diseases are directly proportional to age [4]. India's hypertension and diabetes story look grim in itself. India serves as the diabetes capital for the world, with every fifth diabetic person in the world happens to be an Indian [5]. A meta-analysis conducted on hypertension points towards its overall prevalence being 29.8% in India, with several studies showing an alarming increase in the prevalence rates [6].

Within India, there exist regional differences in the prevalence of hypertension and diabetes. These regional differences in hypertension range from 14.5–35.8% across India [6] and for diabetes, ranging from 3.8–21% [7]. There is also a stark urban-rural divide in the prevalence of both diseases. Various studies show that urban areas are in greater distress than their rural counterparts [6–9]. These variations can be attributed to differences in geographic locations and socio-economic status, lifestyle, dietary habits, etc. [9]. These socio-economic variables are responsible for disparity in prevalence of chronic diseases and variation in the treatment-seeking behavior for the diseases. Health-care seeking behavior is believed to be the summation of environmental factors (such as areas living in) and individual characteristics [10]. A study shows that out of their sample, one-third of patients were aware of their condition; out of these, two-third were on treatment [11]. The education level of an individual plays a significant role in their awareness and facilitates accepting the diagnosis and adapting to the behavioral changes required [12].

As the world steps towards an increase in the aged population, it is safe to assume that morbidities such as hypertension and diabetes would take precedence over any other in terms of its prevalence. With the growing elderly population in India, the burden of these morbidities is bound to increase. Hence, there is an urgent need to understand and factor in the urban-rural divide in the prevalence of hypertension and diabetes to have a targeted approach to tackle the problem. Simultaneously it is also of utmost importance to look into the treatment-seeking approach of patients with hypertension and diabetes to identify the bottlenecks and ensure accessibility and willingness to use formal healthcare services.

The objective of the present study is to estimate the prevalence of hypertension and diabetes among older adults and bring forth the urban-rural differentials in the said morbidities. The treatment-seeking approach of older adults is also looked at with regard to hypertension and diabetes.

## 2. Material And Methods

### 2.1 Data:

The data for this study come from the Longitudinal ageing study of India (LASI) wave one conducted in 2017-18. LASI is the first-ever dataset in India that provides longitudinal data for designing policies and programs in the broad domain of the older population's social, health, and economic well-being. The study was conducted in all 35 states and union territories (except Sikkim). LASI included Indian adults and older adults and women age 45 years and above.

The study adopted a multistage stratified area probability cluster sampling design to collect information from 45 years older adults and above and their spouses irrespective of age. The broader information included chronic diseases among older adults and the elderly population across the socioeconomic spectrum in India and its states and territories. The health modules questions had overall health and specific chronic diseases, organ-based chronic health conditions, and symptoms-based health conditions. Health professionals diagnose chronic diseases like hypertension and diabetes.

The study included a total of 72,250 individuals age 45 years and above, including 31,464 elderly aged 60 years and above and 6,749 oldest persons aged 75 years and above. There was no upper age limit for sample selection, including the collection of biomarkers.

## 2.2 Outcome variables:

The dependent variables for this study are hypertension and diabetes. These health outcomes are based on diagnosis by health professionals. The question included, "has any health professional diagnose you with hypertension and diabetes?" Another outcome variable for this study is the treatment behaviour which was asked, "In order to control your blood pressure or hypertension/ blood sugar or diabetes, are you currently taking any medication?"

## 2.3 Predictor variables:

The study includes some selected socioeconomic and demographic variables which explain the rural-urban gap in hypertension and diabetes among older. The independent variables are age (60–69 years; 70+), marital status (Currently married; never married; divorced/separated/deserted), education (No education; below primary; primary; secondary; higher), religion (Hindu; Muslim; others), currently working (Yes; No), ever used smokeless tobacco (Yes; No) and ever consumed alcohol (Yes; No).

## 2.4 Statistical analysis:

To estimate the prevalence of hypertension and diabetes in rural and urban, bivariate analyses were used to understand the rural-urban gap in hypertension and diabetes with socioeconomic and demographic parameters. Further, logistic regression was used to check the likelihood of hypertension and diabetes with socioeconomic and demographic variables in rural and urban areas. The result was present in the form of an odds ratio, with 95% confidence intervals. Finally, a non-linear decomposition technique like Fairlie's decomposition technique was applied to check the difference in the probability of hypertension and diabetes between rural and urban by estimating contributions of a group (rural-urban) differences. Hence, the non-linear decomposition function,  $Y = F(X_i, \beta)$ , can be express as,

$$Y^U - Y^R = \left[ \sum_{i=1}^{N^U} \frac{F(x_i^U \beta^U)}{N^U} - \sum_{i=1}^{N^R} \frac{F(x_i^R \beta^U)}{N^R} \right] + \left[ \sum_{i=1}^{N^R} \frac{F(x_i^R \beta^U)}{N^R} - \sum_{i=1}^{N^R} \frac{F(x_i^R \beta^R)}{N^R} \right]$$

Where,  $N^j$  is the sample size for group  $j$  ( $j = U$  &  $R$  Urban and Rural),  $Y^j$  is the average probability of a binary outcome of interest for group  $j$ ,  $F$  is the cumulative distribution function from the logistic distribution,  $x_i$  is the set of the average value of the independent variable in group  $j$ , and  $\beta$  is the coefficient estimates for the group  $j$ . the first term in brackets represents the part of the urban-rural gap that is due to group differences in distributions of  $x_i$ . The second term means the part due to differences in the coefficient to the exogenous covariates.

## 3. Results

Table 1 depicts the result for socio-demographic characteristics of the elderly along with the prevalence of hypertension and diabetes among them by various background characteristics. The result noted a higher prevalence of hypertension and diabetes among elderly residing in urban areas than their counterparts for each background characteristic. Furthermore, it was noted that the prevalence of hypertension and diabetes was higher among those aged 70+, females, divorced/separated/deserted, less educated, and non-poor.

Table 2 estimated the odds ratio for hypertension and diabetes among the elderly by their socio-demographic characteristics, separately for rural and urban areas. Results found that females residing in rural areas were 1.47 times more likely to be diagnosed with hypertension than their male counterparts residing in rural areas. Similarly, females residing in urban areas were 1.43 times more likely to be diagnosed with hypertension than their male counterparts residing in urban areas. Never-married elderly were less likely to be diagnosed with hypertension (OR = 0.45; C.I.= 0.21–0.95) and diabetes (OR = 0.20; C.I.= 0.06–0.65) than older people who were currently married in rural areas.

Education among the elderly depicts that those who attained higher education were more likely to be diagnosed with hypertension (OR = 2.09; C.I.= 1.50–2.91) and diabetes (OR = 3.16; C.I.= 2.01–4.96) than those who were uneducated in rural areas. Similarly, elderly with higher education were 2.12 times (OR = 2.12; C.I.= 1.40–3.21) more likely to be diagnosed with hypertension and 1.89 times (OR = 1.89; C.I.= 1.20–2.97) more likely to be diagnosed with diabetes in urban areas than those elderly who were uneducated. Non-poor older people were 1.54 times (OR = 1.54; C.I.= 1.37–1.73) more likely to be diagnosed with hypertension and diabetes (OR = 1.54; C.I.= 1.30–1.83) than poor people in rural areas, also, non-poor people were more likely to diagnosed with diabetes (OR = 1.53; C.I.= 1.23–1.89) than poor people in urban areas.

Table 1  
Sociodemographic characteristics and prevalence of hypertension and diabetes among elderly in urban and rural areas

		Rural			Urban			Total		
		Hypertension	Diabetes	N	Hypertension	Diabetes	N	Hypertension	Diabetes	N
Age group	60–69	25.7	9.5	12,120	44.5	26.5	6,321	31.2	14.5	18,
	70+	28.6	9.1	8,569	50.8	25.7	4,372	35.0	13.9	12,
Sex	Male	23.1	9.6	10,021	41.0	28.0	4,724	28.0	14.6	14,
	Female	30.5	9.2	10,667	51.9	24.7	5,969	37.1	13.9	16,
Marital status	Currently married	25.2	10.1	13,068	44.8	27.6	6,294	30.6	15.0	19,
	never married	15.4	2.5	141	39.4	14.5	87	23.3	6.5	22,
	divorced/separated/deserted	30.1	8.2	7,479	50.6	24.2	4,312	36.5	13.2	11,
Education	No Education	24.5	6.9	13,633	38.9	14.5	3,693	27.0	8.2	17,
	Below primary	30.7	11.0	2,324	45.2	24.5	1,292	35.1	15.1	3,6
	Primary	30.7	13.9	2,065	51.5	29.7	1,527	38.4	19.8	3,5
	Secondary	33.0	16.7	2,341	53.7	36.7	3,093	43.6	27.0	5,1
	Higher	33.6	19.7	323	51.8	32.6	1,088	46.9	29.1	1,2
Religion	Hindu	25.8	9.2	17,281	46.6	26.4	8,572	31.7	14.1	25,
	Muslim	29.9	7.8	2,017	49.1	22.6	1,478	37.0	13.3	3,4
	Others	36.0	13.4	1,390	49.0	31.0	644	39.5	18.1	2,0
Wealth	Poor	21.6	7.0	9,033	41.6	17.8	4,632	27.4	10.1	13,
	Non-poor	31.1	11.2	11,655	51.3	32.5	6,061	37.0	17.5	17,
Currently working	Yes	18.1	6.4	7,156	34.4	19.5	2,169	21.2	8.8	9,5
	No	30.4	11.3	8,553	44.9	26.2	4,732	34.7	15.7	13,
Ever used smokeless tobacco	Yes	22.4	7.4	9,358	40.6	19.3	2,894	26.0	9.7	12,
	No	30.7	11.0	11,231	49.4	28.7	7,709	37.3	17.3	18,
Ever consumed alcohol	Yes	21.3	8.1	3,255	37.7	25.1	1,233	25.1	12.0	4,5
	No	28.0	9.6	17,338	48.2	26.3	9,372	34.1	14.6	26,
Total		26.9	9.4	20,589	47.0	26.1	10,603	32.8	14.2	31,

Table 2  
Estimates of odds ratio for hypertension and diabetes among elderly by their sociodemographic characterises in India

		Rural				Urban			
		Hypertension		Diabetes		Hypertension		Diabetes	
		Odds ratio	CI at 95%	Odds ratio	CI at 95%	Odds ratio	CI at 95%	Odds ratio	CI at 95%
Age group	60–69 <sup>®</sup>								
	70+	1.02	0.90–1.15	0.91	0.76–1.08	1.19	0.96–1.46	0.93	0.73–1.17
Sex	Male <sup>®</sup>								
	Female	1.47***	1.27–1.69	1.15	0.91–1.43	1.43**	1.09–1.88	0.60***	0.46–0.80
Marital status	Currently married <sup>®</sup>								
	never married	0.45**	0.21–0.95	0.20**	0.06–0.65	0.88	0.44–1.77	0.59	0.27–1.25
	divorced/separated/deserted	1.10	0.96–1.25	0.89	0.72–1.08	0.95	0.73–1.22	0.72**	0.55–0.94
Education	No Education <sup>®</sup>								
	Below primary	1.79***	1.46–2.20	1.98***	1.52–2.59	1.31	0.96–1.79	1.60**	1.13–2.27
	Primary	1.72***	1.43–2.08	2.50***	1.90–3.30	1.77***	1.26–2.48	2.34***	1.60–3.42
	Secondary	2.18***	1.84–2.59	3.04***	2.40–3.84	1.93***	1.43–2.61	2.05***	1.51–2.79
	Higher	2.09***	1.50–2.91	3.16***	2.01–4.96	2.12***	1.40–3.21	1.89**	1.20–2.97
Religion	Hindu <sup>®</sup>								
	Muslim	1.21	0.99–1.47	0.85	0.64–1.12	1.27	0.98–1.62	1.06	0.79–1.41
	Others	1.40***	1.16–1.71	1.35**	1.01–1.82	1.04	0.76–1.40	1.46**	1.07–1.99
Wealth	Poor <sup>®</sup>								
	Non-poor	1.54***	1.37–1.73	1.54***	1.30–1.83	1.08	0.87–1.31	1.53***	1.23–1.89
Currently working	Yes <sup>®</sup>								
	No	1.89***	1.67–2.14	2.02***	1.68–2.42	1.40***	1.10–1.77	1.52***	1.14–2.01
Ever used smokeless tobacco	Yes <sup>®</sup>								
	No	1.28***	1.13–1.44	1.45***	1.22–1.73	1.08	0.85–1.36	1.66***	1.32–2.09
Ever consumed alcohol	Yes <sup>®</sup>								
	No	0.99	0.85–1.15	1.04	0.83–1.30	1.05	0.81–1.34	0.95	0.72–1.24

Table 3 examined treatment-seeking for hypertension and diabetes among the elderly by socio-demographic characteristics. A higher percentage of older females were seeking treatment for hypertension and diabetes than their male counterparts. Furthermore, the result found that as education increases, the percentage of older people seeking treatment for hypertension also increases. Nearly 73 percent of non-poor sought treatment for hypertension, whereas almost 80 percent of non-poor people sought treatment for hypertension. Similarly, around 77 percent of poor elderly sought treatment for diabetes, whereas around 84 percent of non-poor elderly sought treatment for diabetes.

Table 3  
Treatment seeking for hypertension and diabetes among elderly by sociodemographic characterises

		Treatment seeking for hypertension	N	Treatment seeking for diabetes	N
Age group	60–69	75.7	6,144	81.7	2,902
	70+	79.5	4,847	81.4	1,956
Sex	Male	76.0	4,420	78.1	2,349
	Female	78.4	6,571	84.9	2,509
Marital status	Currently married	76.4	6,358	81.2	3,161
	never married	73.2	56	62.7	15
	divorced/separated/deserted	78.9	4,577	82.6	1,682
Education	No Education	71.4	5,148	76.8	1,595
	Below primary	78.8	1,354	78.3	593
	Primary	81.1	1,446	86.8	757
	Secondary	84.9	2,403	86.7	1,510
	Higher	86.5	640	76.8	404
Religion	Hindu	76.9	8,771	81.2	3,961
	Muslim	78.4	1,358	82.5	495
	Others	80.8	862	84.2	402
Wealth	Poor	72.6	3,996	77.0	1,503
	Non-poor	80.2	6,995	83.7	3,355
Currently working	Yes	67.4	2,192	72.7	938
	No	78.6	4,941	80.5	2,299
Ever used smokeless tobacco	Yes	71.7	3,482	76.6	1,323
	No	80.0	7,441	83.6	3,501
Ever consumed alcohol	Yes	70.5	1,219	77.0	593
	No	78.2	9,710	82.4	4,236

Table 4  
Logistic regression of treatment seeking for hypertension and diabetes among elderly by sociodemographic characteristics

		Rural				Urban			
		Hypertension		Diabetes		Hypertension		Diabetes	
		Odds ratio	CI at 95 %	Odds ratio	CI at 95 %	Odds ratio	CI at 95 %	Odds ratio	CI at 95 %
Age group	60–69®								
	70+	1.19	0.96–1.47	1.01	0.70–1.43	0.8989432	0.62–1.29	0.87	0.54–1.37
Sex	Male®								
	Female	1.03	0.78–1.34	1.46	0.89–2.38	1.351669	0.82–2.20	1.38	0.75–2.53
Marital status	Currently married®								
	never married	0.27	0.07–1.00	0.05**	0.00–0.50	2.244054	0.35–14.37	0.67	0.09–4.54
	divorced/separated/deserted	0.98	0.75–1.25	0.50***	0.32–0.77	0.8387334	0.52–1.35	1.14	0.65–1.98
Education	No Education®								
	Below primary	1.23	0.86–1.74	1.16	0.68–1.96	2.47***	1.37–4.47	1.00	0.49–2.01
	Primary	1.38	0.99–1.91	2.06**	1.15–3.68	2.03**	1.68–3.54	2.61**	1.09–6.25
	Secondary	1.34	0.98–1.83	1.45	0.90–2.32	2.25***	1.31–3.88	1.77	0.91–3.43
	Higher	1.38	0.77–2.45	1.90	0.75–4.75	2.88***	1.40–5.90	0.81	0.32–2.05
Religion	Hindu®								
	Muslim	0.75	0.54–1.01	1.67	0.89–3.10	1.78**	1.10–2.86	1.37	0.61–3.05
	Others	1.10	0.77–1.54	1.26	0.72–2.19	3.05***	1.63–5.72	1.29	0.62–2.66
Wealth	Poor®								
	Non-poor	1.52***	1.23–1.88	1.80***	1.27–2.56	1.74***	1.18–2.56	1.14	0.70–1.82
Currently working	Yes®								
	No	1.68***	1.35–2.08	1.45**	1.01–2.09	1.63**	1.10–2.42	1.72	0.80–3.70
Ever used smokeless tobacco	Yes®								
	No	1.17***	0.94–1.47	1.34	0.92–1.94	1.450114	0.98–2.14	1.07	0.64–1.74
Ever consumed alcohol	Yes®								
	No	1.30**	1.00–1.69	1.28	0.83–1.97	1.500037	0.95–2.36	0.76	0.43–1.32

Table 4 presents estimates for odds ratio examining the treatment-seeking for hypertension and diabetes among the elderly, separately for rural and urban areas. Results found that older people with higher education were 2.88 times (OR = 2.88; C.I.= 1.40–5.90) more likely to sought treatment for hypertension than uneducated older people in urban areas. As expected, results noticed a higher treatment seeking among non-poor elderly than their counterparts. It was noticed that non-poor older people were more likely to sought treatment for hypertension (OR = 1.52; C.I.= 1.23–1.88) and diabetes (OR = 1.45; C.I.= 1.01–2.09) than older people who were poor in rural areas. Similarly, non-poor older people in urban areas were 1.74 times (OR = 1.74; C.I.= 1.18–2.56) more likely to sought treatment for hypertension than their counterparts.

Table 5 depicts the urban-rural gap in the prevalence of hypertension among the elderly with the help of Fairlie's decomposition analysis. The negative sign to the coefficient depicts that the particular variable contributes to narrowing the inequality gap of hypertension between rural-urban and vice-versa. Results found that age, sex, and wealth are the three variables that narrow the inequality in the rural-urban prevalence of hypertension. In simpler terms, it means that age, sex, and wealth are the variables that are reducing the gap in the prevalence of rural-urban hypertension among the elderly. Furthermore, the result noticed more than four-fifths (88.62%) of the inequality in the prevalence of urban-rural hypertension. It means that the

urban-rural differential in the prevalence of hypertension could be attributed to the educational status of the elderly. The current working status of the elderly is another factor that determines the inequality in the prevalence of hypertension between urban and rural areas.

Table 5  
Decomposition results of the urban and rural gap in hypertension among elderly in India

	Coefficient	Standard error	P-value	Lower CI at 95%	Upper CI at 95%	Percent contribution
Age	-0.0010233	0.000705	0.147	-0.0024	0.000358	-1.93
Sex	-0.0063831	0.002683	0.017	-0.01164	-0.00113	-12.03
Marital Status	0.0003314	0.000918	0.718	-0.00147	0.002131	0.62
Education	0.0470134	0.010132	0	0.027155	0.066872	88.62
Religion	0.0005718	0.0005	0.252	-0.00041	0.001551	1.08
Wealth	-0.0000606	0.000224	0.787	-0.0005	0.000378	-0.11
Currently working	0.0106343	0.003804	0.005	0.003179	0.01809	20.05
Ever used smokeless tobacco	0.0018305	0.00391	0.64	-0.00583	0.009495	3.45
Ever consumed alcohol	0.0002218	0.000435	0.61	-0.00063	0.001074	0.42
<b>Total Explained = 0.05305</b>						

Table 6 depicts the urban-rural gap in the prevalence of diabetes among the elderly with the help of Fairlie's decomposition analysis. Education status of the elderly accounts for more than half (52.02%) of the inequality in the rural-urban prevalence of diabetes. Other important factors that are contributing to the inequality in the rural-urban prevalence of diabetes are ever-used smokeless tobacco (19.54%), currently working status (15.58%), and sex (9.83%).

Table 6  
Decomposition results of the urban and rural gap in diabetes among elderly in India

	Coefficient	Standard error	P-value	Lower CI at 95%	Upper CI at 95%	Percent contribution
Age	0.000193	0.000502	0.7	-0.00079	0.001177	0.32
Sex	0.005856	0.001917	0.002	0.002098	0.009614	9.83
Marital Status	0.001204	0.000786	0.126	-0.00034	0.002744	2.02
Education	0.030991	0.007798	0	0.015707	0.046274	52.02
Religion	0.000448	0.00031	0.149	-0.00016	0.001055	0.75
Wealth	0.00026	0.000675	0.7	-0.00106	0.001584	0.44
Currently working	0.009285	0.003141	0.003	0.003128	0.015441	15.58
Ever used smokeless tobacco	0.011639	0.003046	0	0.005669	0.017608	19.54
Ever consumed alcohol	-0.00033	0.000666	0.62	-0.00163	0.000975	-0.55
<b>Total Explained = 0.059576</b>						

## 4. Discussion

India is currently living through a prodigious wave of demographic change where an increase in life expectancy and decline in fertility have resulted in a dramatic rise in the population of elderly aged 60 years and above. Accompanying the issue of population ageing is the increasing prevalence of chronic diseases among the elderly. The demographic vis-à-vis the epidemiological transition in India has shifted a significant share of disease burden to the older population. Therefore, the objective of this study was to examine the rural-urban differentials in the prevalence and associated factors of chronic diseases (hypertension and diabetes) among the elderly. Also, the study aimed to examine the treatment-seeking approach of the elderly concerning the said diseases.

### 4.1 Prevalence and factors associated with hypertension and diabetes

The results explicitly found that the prevalence of hypertension and diabetes was much higher among the elderly in urban areas than in rural areas. Rapid urbanization is directing a change in lifestyle accompanied by inadequate physical activity and over-dependence on junk food among elderly in urban areas, which is the prime cause of higher diabetes among elderly in urban areas [13–16]. Previous studies are in concordance with this study in finding a higher prevalence of hypertension in urban areas than in rural areas [6, 17]. The higher prevalence of hypertension in urban areas may have arisen due to the rise in cardiovascular disease risk factors among the urban population [18]. Unhealthy dietary practices, consumption of tobacco, and sedentary habits occurring due to rapid urbanization have also contributed to the growing epidemic of hypertension in urban areas of the country [6]. Furthermore, the differences in hypertension prevalence between urban and rural areas could be explained by the differences in socio-economic conditions, risk factors, and quality of healthcare services provided in rural and urban areas [6].



However, previous studies noted a higher risk of hypertension among the elderly with an increase in age [19, 20]; this study failed to notice the statistical differences between a high risk of hypertension and an increase in age among elderly. In rural and urban areas, females were more likely to be diagnosed with hypertension than their male counterparts. Previous studies also noticed this difference and concluded that older females are at higher risk of developing hypertension than older males [20]. It may be due to insufficiency of ovarian hormones during the postmenopausal period [20]. Studies have advocated that ovarian hormones, especially estrogen, may have the potentials to keep blood pressure lower in premenopausal women, and lack of estrogen may be held accountable for elevated blood pressure in postmenopausal women, thus rising hypertension among them [21]. Furthermore, women at advanced age become socially more vulnerable to hypertension as most of such women do not have their spouse alive, affecting their healthcare-seeking and treatment [20]. Female elderly in urban areas were at lower risk of diabetes than their male counterparts in urban areas. Few studies are in concordance with this finding [22, 23]. However, few previous studies noted a higher prevalence of diabetes among female elderly than males [24, 25]. The higher prevalence of diabetes among older men than in older women could be associated with a large amount of visceral fat in men [26].

Among other factors, a higher level of education was responsible for the increased odds of hypertension and diabetes. Educated elderly were at higher risk of having hypertension and diabetes in rural as well as in urban areas than uneducated elderly. The results from decomposition analysis further clarified that education contributes to more than one-fourth of the inequality in the prevalence of hypertension and diabetes among the elderly in India. Previous studies also noticed that the risk of hypertension was higher among the educated elderly [20, 27]. Education levels might improve wealth status, make people follow a sedentary lifestyle, and eventually increase the odds of hypertension [28]. The study found that the diagnosis of hypertension and diabetes was higher among non-poor than in poor. Previous studies have also highlighted a higher burden of diabetes and hypertension among people from the richest wealth quintiles [17, 29–32]. Although the odds of hypertension were higher among non-poor than in poor, the prevalence of hypertension among the elderly suggests that hypertension is also quite prevalent among the poor. Rightly, it was stated that hypertension is not the chronic condition of only the affluent, and it may occur to the poor as well [33]. In the rural area, the odds of diagnosis of hypertension showed a marked positive gradient from poor to non-poor household. It was odds of diabetes that were higher among the elderly in non-poor households than those elderly who belonged to poor households, both in the urban and rural areas. Non-poor elderly tend to adopt a sedentary lifestyle leading to an increased risk of diabetes among them.

## 4.2 Prevalence and factors associated with treatment-seeking of hypertension and diabetes

The most important factor in the discourse of treatment-seeking of hypertension among the elderly is the household wealth status. Results found that the elderly from non-poor households had higher odds to sought treatment for hypertension in rural as well as in urban areas. Previous studies attributed household wealth as an indicator of high treatment-seeking for hypertension in India and elsewhere [34, 35]. It is expected that the elderly from affluent households would seek higher treatment for hypertension than their poor counterparts because of their financial stability. Similarly, the odds of treatment-seeking for diabetes were higher among non-poor rural elderly than their counterparts in poor households. The high cost of treatment could be a cause for lesser odds of seeking treatment for diabetes among the elderly in poor households. Studies have reported that the high cost of treatment could be a deterring factor in utilizing the treatment for hypertension and diabetes [36]. Furthermore, in India, healthcare is financed by out-of-pocket payments and private Health care insurance, which may further favour people from higher socio-economic groups leaving poor people behind [37]. The health financing system in India is out rightly complex than other developing countries [38], and a large chunk of the country's healthcare is provided by unregulated expensive private sector favouring the rich [39–41].

The results noted that the odds of treatment-seeking for hypertension and diabetes were higher among non-working elderly than working elderly. This may be a paragon of paradoxes as common thought reaches the conclusion that working elderly should have better treatment-seeking than their non-working counterparts; however, it is vice-versa. Why it is, so that non-working elderly have higher odds of treatment-seeking than their counterparts. Let us understand this contradiction- Economic dependency is higher among the elderly [42], and 60 + age category is generally a category of the retired working-class, and whosoever is working even after their 60s might require money as they might be poor and may never had permanent income in their entire life. This could be the reason for lower treatment-seeking among working elderly. The odds of treatment-seeking for hypertension were higher among educated elderly than uneducated elderly in urban areas. It is understood that educated elderly might have a better financial status which may further aggravate treatment-seeking. Furthermore, a previous study in the Indian context noted that the elderly with higher education levels are more likely to go for treatment than the uneducated elderly [43].

## 5. Strengths And Limitations Of The Study

The study has some potential limitations. Technically, LASI is a longitudinal survey; however, we were unable to present any trends because this was the first wave of released data. The study used cross-sectional data (since this was the first wave) and, therefore, causality to be inference carefully. Another potential limitation is that the survey did not ask the question on type of treatment for hypertension and diabetes that could differentiate whether the person was taking medicine, following a weight loss program, or observing a change in eating habits. Despite the limitations mentioned above, this study has some considerable strengths. First, hypertension and diabetes are not self-reported and were diagnosed by doctors/health professionals. Self-reported information may be affected by recall biases and reporting errors that may vary by socio-demographic characteristics [17]. Second, this is the latest data (released in 2021) that allow us to present the current picture of the health measures of the elderly by encompassing the sample selection from each state in the country.

## 6. Conclusion

Our study found that the prevalence of hypertension and diabetes was higher among the elderly in urban areas than in rural areas. Hypertension was more prevalent among elderly females in urban areas, highly-educated elderly, non-poor rural elderly, and elderly who were currently not working. Similarly, the risk of diabetes was more prevalent among educated elderly, non-poor elderly, and elderly currently not working. Furthermore, the treatment-seeking for hypertension

was higher among educated elderly in urban areas, non-poor elderly, and elderly not currently working. Similarly, the treatment-seeking for diabetes was higher among non-poor rural elderly and elderly not working in the rural area. The study has a base to provide some policy implications. The unification of geriatric healthcare with the general healthcare system at the primary healthcare level can be a decisive stride in ameliorating the overall health status of older people. The policy-makers should propitious their efforts to address the vulnerability of women in rural as well as in urban areas while designing hypertension prevention and control programs. Since treatment-seeking is relatively low among elderly in poor households, practices must be identified for a poverty-stricken elderly population to overcome the financial barriers that may prevent the elderly from seeking and complying with treatment.

## Declarations

**Ethics approval and consent to participate:** The data is freely available on request and survey agencies that conducted the field survey for the data collection have collected a prior consent from the respondent. The data can be accessed from:

[https://iipsindia.ac.in/sites/default/files/LASI\\_DataRequestForm\\_0.pdf](https://iipsindia.ac.in/sites/default/files/LASI_DataRequestForm_0.pdf)

**Consent for publication:** Not applicable

**Availability of data and materials:** The study utilises secondary source of data which is available on request to everyone through

[https://iipsindia.ac.in/sites/default/files/LASI\\_DataRequestForm\\_0.pdf](https://iipsindia.ac.in/sites/default/files/LASI_DataRequestForm_0.pdf).

**Competing Interest:** The authors declare that they have no competing interests.

**Funding:** Authors did not received any funding to carry out this research.

**Author's Contribution:** The concept was drafted by SK and SC. SK contributed to the analysis design. SC advised on the paper and assisted in paper conceptualization. SC, RP, and SSG contributed in the comprehensive writing of the article. All authors read and approved the final manuscript.

**Acknowledgements:** Not applicable

## Abbreviations

CI

Confidence Interval

LASI

Longitudinal Ageing Study in India

NCD

Non-communicable Disease

OR

Odds Ratio

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