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Original Research Article

Rural-urban disparities in evaluating cardiovascular health- A cross-sectional study from North India

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Abstract

Background: India has made significant strides in improving health outcomes in recent years. However, there remains a notable gap in health status between individuals living in rural and urban areas, including in cardiovascular health.
Aims and Objectives: To better understand these disparities, we conducted an institution-based, cross-sectional study, among 119 patients examining the factors associated with cardiovascular health among both rural and urban populations seeking medical care**.**
Results: The study comprised (69, 58%) males. 58.8% of the subjects belonged to rural areas, with 60 (50.4%) having lower socioeconomic status, and 80 (67.2%) living in joint families. 72.9% of males were smokers and 37 (62.7%) were alcoholics around 76% and 66.7% of individuals under 40 years of age had abnormal cardiovascular health in urban and rural areas, respectively. In urban areas, a higher percentage of individuals who smoke and consume alcohol have abnormal cardiovascular health status, compared to rural areas. However, a higher percentage of individuals with such health status reside in rural areas despite the lower incidence of comorbidities. Even though rural areas had more COVID cases, only 83% of them showed abnormal cardiovascular health status.
Conclusion: To mitigate the incidence of cardiovascular disease (CVD) in rural and remote communities, it is imperative to address the underlying factors that give rise to poor cardiovascular health. This necessitates a collaborative approach that entails forging authentic partnerships spanning diverse sectors, active community engagement, and a long-term commitment to securing viable solutions.

Keywords: Cardiovascular Health, Rural-urban disparities, Sex-differences, Age-difference, Echocardiography.

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1. Introduction

Cardiovascular disease (CVD) describes all diseases and health-related issues that affect the heart and blood vessels, including heart attack, coronary heart disease, stroke, heart failure, etc. Rural patients encounter distinct challenges regarding social determinants of health, underinsurance, cardiovascular comorbidities, and healthcare delivery system factors including limited access to specialized care due to distance and fewer available hospitals. Cardiovascular diseases (CVD) remain a leading cause of death worldwide, responsible for 32% of all deaths.[1,2] Due to the transition of epidemiology and the effect of urbanization, there has been a change in environmental and lifestyle factors that can affect individual health and well-being per se types of diseases that people are experiencing.[3,4] Rural-urban disparities have been reported for various chronic conditions, including cardiovascular diseases. Despite improvements in healthcare, India still experiences rural-urban health disparities because improvements in rural areas have lagged behind those in urban areas.[5-7] This is on the backdrop of the well-documented fact that rural areas typically have worse health and higher mortality rates than urban areas.[8,9]

Many studies have found that people in rural areas are likelier to have poorer health profiles than those in urban areas. This is thought to be because of several modifiable as well as non-modifiable factors, such as their background characteristics (Age, sex, lifestyle, obesity, blood pressure, sedentary habit, addiction, comorbidities, COVID-19

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infection, etc.), lower socioeconomic status, reduced access to healthcare, lower awareness, lower health-seeking behavior, and different performance of the healthcare system. During the past years, the COVID-19 pandemic has disrupted healthcare delivery in urban and rural areas, leading to a significant loss of life expectancy. The pandemic has also resulted in major economic, social, and political challenges.[5,10] While various efforts have been made by the government, to reduce these health disparities, it is unclear whether people living in rural and urban areas have benefited equally from these policies and initiatives.[6,11-14]

Along with assessing risk factors, physical and clinical examination is essential to assess cardiovascular health. Since our institution serves both urban and rural populations due to its spatial location there is a paucity of data or research on rural-urban differences as well as associated factors in cardiovascular health status. Hence, we have conducted the study to explore the disparities in the cardiovascular health spectrum and its associated factors between rural and urban subjects attending the health facility.

2. Materials and Methods

The institution-based, cross-sectional study was conducted among 119 patients attending outpatient departments (OPD), indoor patient departments (IPD), and emergency/ causality of a tertiary health facility, seeking cardiac consultation. After taking informed consent, all symptomatic patients of either sex or any age, having complaints of dyspnoea, orthopnoea, and/ or chest pain, and referred to the cardiology department for preoperative cardiology clearance were recruited. Those who had not given consent or were non-cooperative were excluded. Detailed history, examinations (demographics, anthropometric measurements, clinical risk factors, co-morbidities, etc.), investigations (laboratory and traditional imaging techniques), and appropriate management were made according to standard guidelines.

2.1. Echocardiography

2-D Trans-thoracic echo (TTE) was performed on all patients attending cardiac OPD using the "*Hitachi M00617LI*" echocardiography machine. The assessment of left ventricular (LV) systolic and diastolic function, LV ejection fraction (LVEF), LV geometry, and measurements of other echo indices were done according to the recommended image-acquisition protocol that includes parasternal imaging and apical, subcostal, suprasternal, off-axis. In the parasternal long-axis view, the internal diameters of LV in end-systole and diastole, the interventricular septum, and posterior wall thickness at end-diastole were measured. LV mass was calculated and indexed to body surface area. The relative wall thickness was calculated as (2 x LV posterior wall thickness/LV internal end-diastolic diameter). Based on LV mass and relative wall thickness left ventricular geometry was categorized as normal, concentric remodeling, concentric, or eccentric (dilated) hypertrophy.[15,16]

2.2. Chest x-ray and electrocardiogram

A chest X-ray posteroanterior (PA) view was performed on each subject. A cardiothoracic ratio (CTR) >0.5, was considered as cardiac hypertrophy. Using the Sokolow-Lyon index of ECG (S wave in V1 + R wave in V5/V6 >35mm) was considered as LVH irrespective of sex.[7]

2.3. Data collection and statistical analysis

Data were collected by the principal investigator on the "same day of admission" and "day of the discharge" of patients to assure recall of the patient circumstances by the ordering as well as treating physician with "total enumerative non-random sampling". Data collection was done by Epicollect 5.0 and analyzed by Jamovi 2.2.5.0. Normal data distribution was visualized by "q-q plot" for all the continuous variables and was presented as Mean ± SD or median and interquartile range (IQR). Normal data distribution was visualized by "q-q plot" for all the continuous variables and was presented as Mean ± SD or median and interquartile range (IQR). Mann-Whitney U test was run for the continuous variable which didn't meet the criteria of normal distribution and homogeneity of variance ($p>0.05$) (Levene's test). Categorical variables were presented as frequency (n), and percentage (%). To infer statistical significance: 95% confidence intervals (CI) and p-value (<0.05) were considered. Except "the height" of the subjects being non-normal**.**

2.4. Ethics statement

Ethical approval was obtained from the Institutional Ethical and Research Advisory Committee and all procedures followed Helsinki guidelines. Confidentiality of the given information was maintained.

3. Results

3.1. Clinical & socio-demographic profile

The study comprised (69, 58%) males. 58.8% of the subjects belonged to rural areas, with 60 (50.4%) having lower socioeconomic status, and 80 (67.2%) living in joint families. 72.9% of males were smokers and 37 (62.7%) were alcoholics. 100 (84%) were married. 70 (58.8%) subjects had no comorbidities. 12 (10%) were diabetic, and 33 (27.7%) were hypertensive. 8 (6.7%) had ischemic heart disease. One subject had left atrial myxoma and atrial septal defect. The mean age of rural subjects was higher than urban subjects 55.3 (±14.9) vs 46.4 (±20.1) (**Table 1**).

In **Figure 1**, the stratification of cardiovascular diseases is described according to age. It shows that under the age of 40, around 76% and 66.7%, had abnormal cardiovascular health status in urban and rural areas respectively. In the 41-59 age group, 90% of rural subjects had abnormal CV health status compared to 83% of subjects from urban areas.

Table 1: Clinical profile of the subjects

Variable	Rural (n=70)	Urban (n=49)	p-value	95% CI
Age* (yrs.)	55.3 (±14.9)	46.4 (±20.1)	0.006	(2.57- 15.3)
Body mass index# (BMI) kg/m2	20.62 (2.28)	20.31 (3.20)	0.500	(-0.55-1.1)
Systolic blood pressure# (SBP) mmHg	134 (15.5)	128 (18)	0.229	(-2.0- 8.0)
Diastolic blood pressure# (DBP) mmHg	81 (12)	82 (12)	0.466	(-4.0- 2.0)
Random blood sugar# (RBS) mg/dl	98 (7)	98 (10)	0.568	(-2.0- 4.0)
* Mean (SD); Independent Samples T-Test; Levene's test is significant (p < .05) # Median (IQR); Mann-Whitney U test; Levene's test is non-significant (p > .05).				

Table 2: Socio-cultural factors associated with CVD health status (rural Vs urban)

Variable		Rural (n= 70)				Urban (n= 49)			
		n	CVD present	P value	OR (95% CI)	n	CVD present	P value	OR (95% CI)
Age (yrs.)	<40	9	6 (66.6%)	0.14	------	17	13 (76.5 %)	0.78	-----
	41-59	32	29 (90.6 %)			18	15 (83.3 %)		
	>/=60	29	26 (89.7 %)			14	12 (85.7%)		
Sex	Female	30	27 (90%)	0.54	1.59 (0.36-6.94)	20	16 (80%)	0.81	0.83 (0.19-3.58)
	Male	40	34 (85%)			29	24 (82.8%)		
Education	Illiterate	12	9 (75 %)	0.11	------	5	5 (100%)	0.05	------
	<HS	29	28 (96.6 %)			18	17 (94.4 %)		
	>HS	29	24 (82.8 %)			26	18 (69.2 %)		
SES	Upper	2	2 (100 %)	0.69	------	4	2 (50%)	0.21	------
	Middle	31	26 (83.9 %)			22	18 (81.8 %)		
	Lower	37	33 (89.2 %)			23	20 (87.0 %)		
Smoker	Yes	28	25 (89.3 %)	0.66	0.72 (0.16-3.15)	21	20 (95.2 %)	0.03	0.125 (0.01- 1.09)
	No	42	36 (85.7 %)			28	20 (71.4 %)		
Alcohol addiction	Yes	7	5 (71.4%)	0.19	3.20 (0.52- 19.72)	12	11 (91.7 %)	0.30	0.33 (0.04- 2.95)
	No	63	56 (88.9 %)			37	29 (78.4 %)		
Contracted Covid-19	No	21	20 (95.2 %)	0.185	3.90 (0.46-33.40	43	34 (79.1 %)	0.215	3.58[a] (0.185-69.4)
	Yes	49	41(83.7 %)			6	6 (100%)		
Covid vaccination	Absent	20	18 (90 %)	0.652	1.47 (0.28-7.74)	41	33 (80.5 %)	0.639	1.70 (0.18-15.83)
	Present	50	43 (86.0 %)			8	7 (87.5 %)		
Comorbidities	Absent	45	38 (84.4 %)	0.366	0.47 (0.09- 2.47)	25	19 (76 %)	0.299	0.45 (0.099-2.07)
	Present	25	23 (92%)			24	21(87.5 %)		
OR=Unadjusted Odds Ratio; < HS= Up to high-school; > HS= above high-school; SES=socioeconomic status; [a] Haldane-Anscombe correction applied;									

Figure 2 describes the stratification of cardiovascular diseases is described according to sex in rural-urban areas. Both male (85%) and female (90%) populations in rural areas exhibit a higher proportion of abnormal cardiovascular health status compared to those in urban areas (83% and 80% respectively) (**Figure 2**). According to the study, individuals living in rural areas have a higher likelihood of experiencing abnormal cardiovascular health compared to those living in urban areas, regardless of their economic status.

In urban areas, a greater percentage of individuals who smoke and consume alcohol demonstrate an abnormal cardiovascular health status (95% and 91.7%) compared to their counterparts in rural areas (89% and 71%) respectively. Despite the lower incidence of comorbidities in rural areas, a higher share (92%) of individuals with abnormal cardiovascular health status resides in rural areas.

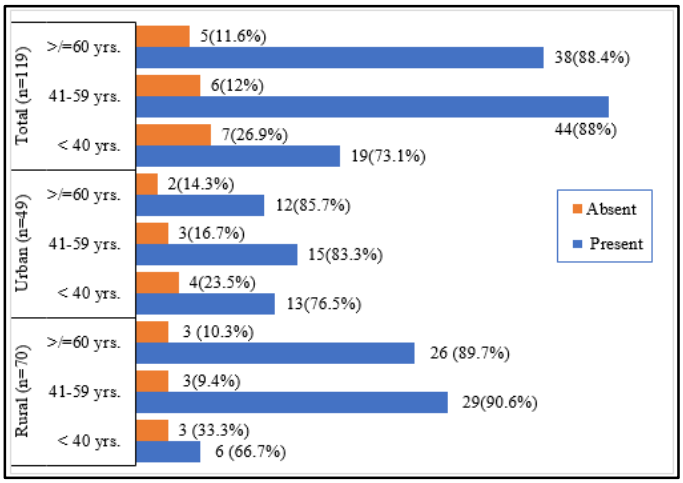

Figure 1: Age difference in Rural-urban CVD status

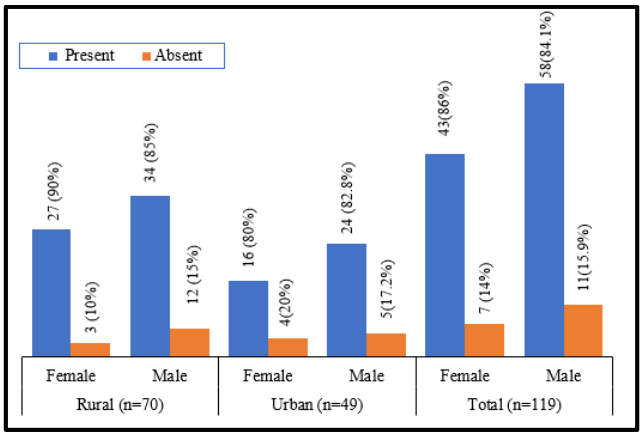

Figure 2*:* Rural-urban CVDs stratified according to sex

Although rural areas had more COVID cases, only 83% of them showed abnormal cardiovascular health (**Table 2**).

4. Discussion

Patients residing in rural areas are particularly susceptible to various challenges related to social determinants of health, underinsurance, the presence of cardiovascular comorbidities, and delivery system factors. These factors include limited hospital facilities that are located at remote distances, leading to reduced access to specialist care.[17] The study indicates that there is a noteworthy number of individuals, particularly those under the age of 40, had abnormal cardiovascular health status in both urban (76%) and rural areas (66.7%). In the age group of 41-59, 90% of rural and 83% of urban participants had an abnormal CV health status. This information highlights the need for further attention and resources to address this concerning issue and it would be beneficial to investigate the potential factors that may contribute to the presence of CVDs in individuals before the age of 40.

The mean value of systolic blood pressure was found to be higher among rural subjects than urban. The study done by Aggarwal et al has also demonstrated that hypertension-related deaths have increased across all populations, but this rise has been most pronounced among rural Black adults.[6]

It has been observed that there exists a difference in the prevalence of abnormal cardiovascular health status between individuals living in rural and urban areas. In rural areas, both male and female populations demonstrate a slightly higher percentage of abnormal cardiovascular health status relative to their urban counterparts. According to Chaganty et al, the study showed that there was an increase in deaths related to cardiovascular disease (CVD) among both males and females in both urban and rural areas. The excess deaths were higher in urban areas (males 24,282 (7.5%), females 27,728 (7.5%)) than in rural areas (males 20,997 (6.5%), females 23,489 (6.4%)).[5]

The findings of the study indicate that the incidence of abnormal cardiovascular health in rural communities is higher than in urban areas, regardless of economic status. This implies that individuals residing in rural areas may be at a greater risk of experiencing cardiovascular health complications than their urban counterparts. Therefore, further research is needed to explore the underlying factors that contribute to this disparity and to develop effective interventions that can improve cardiovascular health outcomes in rural populations.[18]

Within urban areas, a slightly larger proportion of individuals who smoke and consume alcohol exhibit an abnormal cardiovascular health status compared to those in rural areas respectively. Notwithstanding the lower incidence of comorbidities in rural areas, a greater percentage of individuals with abnormal cardiovascular health status reside in rural areas. This highlights the need for targeted interventions to address the issue and improve the cardiovascular health of the affected populations.

Despite the higher incidence of COVID-19 cases in rural areas, it has been observed that a considerable proportion of individuals (83%) have exhibited abnormal cardiovascular health status. It is important to note this finding, as it may have significant implications for healthcare providers and policymakers who are responsible for developing effective and evidence-based strategies to prevent and manage COVID-19 in rural communities. Despite the challenges that arose during the first year of the COVID-19 pandemic in 2020, it's important to recognize the impact it had on CVD-related mortality rates in both rural and urban areas.[5] By acknowledging this increase, we can work towards implementing better solutions to prevent such excess deaths in the future. Further research is warranted to understand the underlying mechanisms and to identify potential risk factors that contribute to this phenomenon.

5. Conclusion

To prevent cardiovascular disease (CVD) in rural and remote communities, we need to address the underlying causes of poor cardiovascular health. This requires a collaborative effort that involves genuine partnerships across sectors, active community engagement, and a long-term commitment to solutions. By working together, we can tailor public health programs to address the specific needs of rural and remote communities, while involving local organizations and stakeholders who can better understand the needs of their population.

It is important to support the primary healthcare workforce in providing integrated health checks to promote early detection of those at risk of CVD. Ongoing health professional education is crucial to ensure that absolute risk assessment and management of CVD risk factors are updated. Additionally, we need to raise awareness of CVD risk in the general population through programs that educate and empower people to take control of their health.

In settings where healthcare resources are scarce, we can build capacity and improve access to prevention and treatment by supporting health promotion in pharmacies and non-clinical settings. By taking a constructive approach and working collaboratively, CVD can be prevented and the health outcomes of rural and remote populations can be improved.

6. Limitations

It is important to note that this study's cross-sectional design does not allow for the establishment of causal inferences. Additionally, the small sample size and institutional setting are only representative of similar settings and cannot be validated externally. Therefore, to ensure greater accuracy and reliability, future studies should utilize larger sample sizes and more representative populations, as well as employ properly designed and long-lasting comparative studies or randomized controlled trials.

7. Source of Funding

None.

8. Conflict of Interest

None.

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