Short Reports

Epidemiology of heart failure in rural Chhattisgarh, India

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ABSTRACT

Background. Cardiovascular diseases, including heart failure (HF), are leading causes of death and disability in India. However, most studies in India only include urban populations or rural regions with improved access and may not represent the poorest patients or regions. We studied the epidemiology of HF patients admitted to a secondary care hospital in rural Chhattisgarh, India.

Methods. We did a retrospective chart review of patients hospitalized with HF in 2018 to obtain their demographic data and risk factors for developing HF. We reviewed echocardiograms to assign patients to their most probable HF category.

Results. We studied 88 HF patients with a mean age of 42 years including 55 (62.5%) women. The most common categories of HF were cardiomyopathy (36.8%), rheumatic heart disease (RHD; 25.3%) and right heart failure (RHF; 18.4%). Prior tuberculosis was more prevalent in patients with RHF compared with other types of HF (43.8% *v.* 13.9%).

Conclusions. HF patients in this study from rural central India were young and predominantly women. Cardiomyopathy, RHD and RHF due to past tuberculosis were common causes of HF in this population. Further studies are needed to expand upon these single centre findings to better understand the risk factors and outcomes of HF among the rural poor.

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INTRODUCTION

Cardiovascular diseases (CVDs) are the leading cause of death and disability in India resulting in an estimated 14.1% of disability-adjusted life years.[1] CVDs, including heart failure (HF), are leading causes of death and disability in both urban and rural India.[2] Estimates suggest a HF prevalence of 1.3 million to 22.7 million, with an annual incidence of 0.5–1.8 million in India.[3,4]

In urban areas and high-income states, ischaemic heart disease (IHD) is the leading cause of HF.[5] However, this may not be representative of rural areas. In low- and middle-income countries (LMICs), the portion of HF attributable to IHD in rural areas is less than 1%, but in urban areas can be as high as 18%.[6] In rural settings, rheumatic heart disease (RHD), non-ischaemic cardiomyopathies, congenital anomalies, and right heart failure (RHF) are larger contributors to HF burden rather than traditional risk factors such as atherosclerosis.[6,7]

We describe the characteristics of patients hospitalized for HF in a secondary care hospital in Chhattisgarh in rural central India. The hospital serves primarily indigenous populations and other traditionally deprived social groups. We report HF categories, prevalence of traditional CVD risk factors, and characteristics of HF based on caste as a proxy for structural violence.[8]

METHODS

Study setting

Jan Swasthya Sahyog (JSS) is a not-for-profit, non-governmental secondary care hospital in the state of Chhattisgarh in rural central India. The hospital serves a population of 1.5 million in Madhya Pradesh and Chhattisgarh. Approximately one-third of patients are from tribal communities, and nearly 90% of the patients live below the poverty line.[9]

Study population

We conducted a retrospective observational study on all patients admitted to JSS with HF in 2017. We reviewed both electronic medical records (EMR) and paper chart data to include patients with at least two of the following: symptoms of HF, clinical signs of HF, and/or diagnostics test results supporting HF.

Social categories

We categorized patients into groups based on caste, as designated by the government: Scheduled Tribes (ST), Scheduled Caste (SC) and Other Backward Class (OBC). We classified the remaining individuals as 'General'.

HF categories

We used echocardiogram reports to assign a single probable diagnostic category to each patient.[7,10] We defined cardiomyopathy as subjects with left ventricular ejection fraction <45%, combining heart failure with reduced ejection fraction and mid-range ejection fraction. We categorized patients as RHD with rheumatic valve changes and at least moderate stenosis or regurgitation. We assigned RHF to those with right ventricle dilatation and/or elevated right ventricular systolic

pressure along with normal left ventricular systolic function and normal mitral and aortic valves. We categorized patients as hypertensive heart disease if they had normal left ventricular systolic function and blood pressure >180/110 mmHg during admission. Congenital heart disease was assigned if there were abnormal structures including atrial or ventricular septal defects.

Statistical analyses

We reported continuous variables as mean and standard deviation (SD), and categorical data as proportions. Fisher's exact test was used to assess statistical significance of differences in categorical variables between groups. Odds ratios for risk factors for RHF were calculated using univariate analysis. Analyses were conducted using Stata version 16.0 (StataCorp, College Station, TX).

Ethics approval

The study was approved by the research ethics review boards at Emmanuel Hospital Association, New Delhi, India, and Boston University Medical Campus, Boston, USA.

RESULTS

Of 101 patients identified in the initial screening, 88 were admitted with HF during the study period. Fifty-five patients (62.9%) were women and the mean age was 42.1 years (Table I). The largest social category in our cohort was ST, followed by SC and OBC. The mean BMI at admission was 17.9 kg/m^2, and over half our patients were underweight.

Tobacco use was more common in men than women, as was hypertension. One in 5 patients had prior pulmonary tuberculosis, while only 7% of patients had diabetes. The median duration of symptoms at presentation was 90 days for men and 30 days for women.

We were able to categorize HF type in 87 patients (Table II). Cardiomyopathy was the most common HF category, followed by RHD and isolated RHF. Of the 32 patients with cardiomyopathy, 5 had coexistent RHD, 5 had peripartum cardiomyopathy, 3 had suspected alcoholic cardiomyopathy, and 2 had suspected myocarditis. Detailed echocardiographic parameters for each category of HF are shown in Supplementary Table II.

In patients with isolated RHF, prior tuberculosis was strongly associated with developing isolated RHF (OR 4.74; Table III). Tobacco use was also associated with a six-fold higher odds of RHF.

DISCUSSION

We studied the epidemiology of HF and clinical outcomes of patients from socially vulnerable communities in rural Chhattisgarh and Madhya Pradesh. Although rural India is also diverse, our study shows that a rural population faces specific risk factors that lead to different aetiologies of HF than in urban India. Patients in our cohort were young and predominantly women. The categories of HF were primarily cardiomyopathy, RHD and RHF. The prevalence of traditional cardiovascular risk factors was low.

Our study is unique in its focus on a rural impoverished population. People living in severe poverty are under-represented in prior studies of HF in India. The Trivandrum Heart Failure Registry (THFR) studied 1205 patients from 13 urban and 5 rural hospitals in Kerala. However, patients from rural hospitals comprised <10% of the cohort analysed[11] and the prevalence of poverty in rural Kerala (12%) is far less than that in rural Chhattisgarh (55%) or Madhya Pradesh (42%).[12] The INDUS study surveyed over 10 000 people in a rural community setting for HF, but only 12 patients were identified by symptoms.[13]

The risk factors for HF in our cohort are similar to those in other rural low-income countries such as Rwanda and Haiti,[6] while different from studies in urban India. HF patients in our study were much younger (42 years) than those in urban India

TABLE I. Characteristics of patients admitted with heart failure (HF) in rural Chhattisgarh

Characteristic	Men *n* (%)	Women *n* (%)	Total *n* (%)
Total, *n* (%)	33 (37.5)	55 (62.5)	88
Age at admission (years), mean (SD)	47.4 (21.2)	38.8 (19.2)	42.1 (20.3)
0–18	4 (12.1)	9 (16.4)	13 (14.8)
19–45	10 (30.3)	23 (41.8)	33 (37.5)
46–65	13 (39.4)	21 (38.2)	34 (38.6)
>65	6 (18.2)	2 (3.6)	8 (9.1)
Caste			
Scheduled Caste	12 (36.3)	12 (21.8)	24 (27.3)
Scheduled Tribe	10 (30.3)	27 (49.1)	37 (67.3)
Other Backward Caste	10 (30.3)	14 (25.5)	24 (27.3)
General	1 (3.0)	1 (1.8)	2 (2.3)
Unknown	0 (0)	1 (1.8)	1 (1.1)
*BMI (kg/m^2), mean (SD)**	18.2 (3.5)	17.7 (3.9)	17.9 (3.7)
<18.5	15 (60.0)	20 (62.5)	35 (61.4)
18.5–22.9	7 (28.0)	10 (31.4)	17 (29.8)
>23	3 (12.0)	2 (6.3)	5 (8.8)
Comorbid conditions			
Tobacco use	9 (27.2)	1 (1.8)	10 (11.4)
Hypertension	7 (21.2)	3 (5.4)	10 (11.4)
Diabetes	3 (9.1)	3 (5.4)	6 (6.8)
Prior pulmonary tuberculosis	7 (21.2)	10 (18.2)	17 (19.3)
Duration of symptoms median (Q1, Q3)	90 (18, 172)	30 (11, 172)	81 (13, 180)
0–30 days	12 (40.0)	31 (62.7)	43 (53.8)
>30 days–1 year	15 (50.0)	14 (27.4)	29 (36.3)
>1 year–2 years	2 (6.7)	2 (3.9)	4 (5.0)
>2 years	1 (3.3)	3 (5.9)	4 (5.0)
Admission laboratory data			
Haemoglobin g/dl, mean (*n*)†	10.4 (23)	10.5 (50)	10.4 (73)
Sodium mmol/L, mean (*n*)†	133.6 (13)	133.9 (25)	133.8 (38)
Creatinine mg/dl, median (*n*)†	1.6 (22)	1.1 (44)	1.3 (66)

* Data available for 57 patients: 25 men, 32 women † *n* listed is less than the total number of patients due to missing data

TABLE II. Inpatient heart failure aetiologies in rural Chhattisgarh

Cause of heart failure	Men *n* (%)	Women *n* (%)	Total *n* (%)
Cardiomyopathy	13 (39.4)	19 (35.2)	32 (36.8)
Due to RHD	2 (6.1)	3 (5.6)	5 (5.7)
RHD without cardiomyopathy	6 (18.2)	16 (29.6)	22 (25.3)
Right heart failure	7 (21.2)	9 (16.7)	16 (18.4)
Congenital heart disease	3 (9.1)	5 (9.3)	8 (9.2)
Hypertension	2 (6.1)	2 (3.7)	4 (4.6)
Other	2 (6.1)	1 (1.9)	3 (3.4)
Normal echocardiogram	0 (0)	2 (3.7)	2 (2.3)
Total	33	54	87

RHD rheumatic heart disease

TABLE III. Patient characteristics of right heart failure in rural Chhattisgarh

Characteristic	RHF (*n*=16) *n* (%)	No RHF (*n*=71) *n* (%)	Odds ratio (95% CI)
Age			
<45 years	4 (25.0)	40 (56.3)	3.87 (1.14, 13.18)
>45 years*	12 (75.0)	31 (43.6)	–
Gender			
Men	7 (43.8)	26 (33.3)	0.74 (0.25, 2.23)
Women*	9 (56.3)	45 (66.7)	–
Tuberculosis	7 (43.8)	10 (13.9)	4.74 (1.44, 15.64)
Smoking	5 (31.3)	5 (6.9)	6.00 (1.49, 24.19)
Diabetes	1 (6.3)	9 (12.5)	–
Hypertension	1 (6.3)	5 (6.9)	–
Length of stay	6.9 (5.0)	5.9 (4.1)	–
Death	1 (6.3)	6 (8.5)	–

* reference category

(53–61 years old).[11,14–17] Patients in our study had a lower prevalence of traditional cardiovascular risk factors including diabetes (7% *v*. 46%–66%), hypertension (11% *v*. 34%–58%), and tobacco consumption (11% *v*. 38%–42%) compared with earlier Indian studies.[11,14,15,17] While a majority of patients in other studies were overweight or obese,[15,17] 50% of our patients with HF were underweight. Furthermore, the SC and ST groups had the lowest prevalence of diabetes, hypertension, tobacco use and obesity, reflecting an inverse association between the degree of poverty and traditional risk factors for CVD.

While IHD is the leading (40%–72%) cause of HF in studies from urban India and high-income countries,[3,4,11,14,16,18,19] it may be a minority cause among the 69% of Indians who live in rural areas. In our cohort, cardiomyopathy was the most common category of HF, but only 7 patients had features of possible ischaemic cardiomyopathy including regional wall motion abnormalities or prior history of myocardial infarction.

RHD was a common cause of HF in about one-third of our cohort. The reported percentage of HF in India attributable to RHD varies greatly (3.5%–52%) with most studies reporting less than our study,[3,4,11,13,14,18] again highlighting the heterogeneity of India and the importance of studies focused on rural populations.

A fair proportion of patients had isolated RHF. Although described in other LMICs as developing secondary to chronic obstructive pulmonary disease (COPD), TB and indoor air pollution,[7,20] RHF has not been described in HF studies from India.[11,15,19] Consistent with prior studies, both smoking and TB were associated with RHF in our study. Post-mortem studies show that between 3.7% and 46% of patients with pulmonary TB develop RHF.[21] However, RHF is a late manifestation of untreated pulmonary disease, taking an average of 16 years to develop.[22] We suspect that studies from urban India did not report TB as an important aetiology of RHF, because patients from these settings do not face the same social and structural barriers to care as rural India.

Limitations

Our study has several important limitations. First, it is retrospective, observational and there were missing data, limiting interpretations on causality and temporality. Second, CVD risk factors such as history of hypertension, diabetes, tobacco use or prior TB were self-reported and are likely underestimated. Third, due to diagnostic limitations such as non-availability of cardiac catheterization, full echocardiography or on-site cardiologists, the causes of HF in some patients may have been misclassified. Finally, our sample size is small, but our data are critical in understanding HF in a previously understudied vulnerable population and highlights the need for a larger study.

Conclusion

We identified the most common categories of HF in rural Chhattisgarh and Madhya Pradesh: cardiomyopathy, RHD and RHF. Poverty-related factors such as belonging to a ST or SC, TB, RF, malnutrition, anaemia, gender disparities, and lack of robust primary healthcare systems may play a large role in the causation of HF in rural India. This differs from studies from urban India or the West where IHD is the most prevalent aetiology. Health providers and policy-makers alike should address the structural aspects that determine clinical outcomes when counselling patients or designing national programmes aimed at reducing the burden of HF in India.

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Conflicts of interest. None declared

REFERENCES

1 India State-Level Disease Burden Initiative Collaborators. Nations within a nation: Variations in epidemiological transition across the states of India, 1990–2016 in the Global Burden of Disease Study. *Lancet* 2017;**390:**2437–60. Erratum in: *Lancet* 2017;**390:**e49.
2 Prabhakaran D, Jeemon P, Roy A. Cardiovascular diseases in India: Current epidemiology and future directions. *Circulation* 2016;**133:**1605–20.
3 Pillai HS, Ganapathi S. Heart failure in South Asia. *Curr Cardiol Rev* 2013;**9:** 102–11.
4 Huffman MD, Prabhakaran D. Heart failure: Epidemiology and prevention in India. *Natl Med J India* 2010;**23:**283–8.
5 Mishra AK, Sugdeb V, Lahiri A, Ramya I. Outcomes related to acute decompensated heart failure admissions: A pilot study. *Curr Med Issues* 2018;**16:**52.
6 Kwan GF, Mayosi BM, Mocumbi AO, Miranda JJ, Ezzati M, Jain Y, *et al*. Endemic cardiovascular diseases of the poorest billion. *Circulation* 2016;**133:**2561–75.
7 Kwan GF, Jean-Baptiste W, Cleophat P, Leandre F, Louine M, Luma M, *et al*. Descriptive epidemiology and short-term outcomes of heart failure hospitalisation in rural Haiti. *Heart* 2016;**102:**140–6.
8 Muthukkaruppan P. Critique of caste violence: Explorations in theory. *Soc Scientist* 2017;**45:**49–71.
9 Jain Y, Kataria R, Patil S, Kadam S, Kataria A, Jain R, *et al*. Burden and pattern of illnesses among the tribal communities in central India: A report from a community health programme. *Indian J Med Res* 2015;**141:**663–72.
10 Kwan GF, Bukhman AK, Miller AC, Ngoga G, Mucumbitsi J, Bavuma C, *et al*. A simplified echocardiographic strategy for heart failure diagnosis and management within an integrated noncommunicable disease clinic at district hospital level for sub-Saharan Africa. *JACC Heart Fail* 2013;**1:**230–6.
11 Harikrishnan S, Sanjay G, Anees T, Viswanathan S, Vijayaraghavan G, Bahuleyan CG, *et al*. Clinical presentation, management, in-hospital and 90-day outcomes of heart failure patients in Trivandrum, Kerala, India: The Trivandrum Heart Failure Registry. *Eur J Heart Fail* 2015;**17:**794–800.
12 Panagariya A, Mukim M. A comprehensive analysis of poverty in India. *Asian Dev Rev* 2014;**31:**1–52.
13 Chaturvedi V, Parakh N, Seth S, Bhargava B, Ramakrishnan S, Roy A, *et al*. Heart

failure in India: The INDUS (INDIA UKIERI STUDY) study. *J Pract Cardiovasc Sci* 2016;**2:**28–35.
14 Seth S, Khanal S, Ramakrishnan S, Gupta N, Bahl V. Epidemiology of acute decompensated heart failure in India: The AFAR study (Acute failure registry study). *J Pract Cardiovasc Sci* 2015;**1:**35. Available at *http://dx.doi.org/10.4103/2395-5414.157563* (accessed on 20 Mar 2021).
15 Lam CS, Teng TK, Tay WT, Anand I, Zhang S, Shimizu W, *et al*. Regional and ethnic differences among patients with heart failure in Asia: The Asian sudden cardiac death in heart failure registry. *Eur Heart J* 2016;**37:**3141–53.
16 Suman OS, Vijayaraghavan G, Muneer AR, Ramesh N, Harikrishnan S, Kalyagin AN. Long-term outcomes of patients admitted with heart failure in a tertiary care center in India. *Indian Heart J* 2018;**70** (Suppl 1):S85–S89.
17 Pokharel Y, Wei J, Hira RS, Kalra A, Shore S, Kerkar PG, *et al*. Guideline-directed medication use in patients with heart failure with reduced ejection fraction in India: American College of Cardiology's PINNACLE India Quality Improvement Program. *Clin Cardiol* 2016;**39:**145–9.
18 Mishra S, Mohan JC, Nair T, Chopra VK, Harikrishnan S, Guha S, *et al*. Management protocols for chronic heart failure in India. *Indian Heart J* 2018;**70:**105–27.
19 Dokainish H, Teo K, Zhu J, Roy A, AlHabib KF, ElSayed A, *et al*. Global mortality variations in patients with heart failure: Results from the International Congestive Heart Failure (INTER-CHF) prospective cohort study. *Lancet Glob Health* 2017;**5:**e665–e672. Erratum in: *Lancet Glob Health* 2017;**5:**e664.
20 Stewart S, Mocumbi AO, Carrington MJ, Pretorius S, Burton R, Sliwa K. A not-so-rare form of heart failure in urban black Africans: Pathways to right heart failure in the Heart of Soweto Study cohort. *Eur J Heart Fail* 2011;**13:**1070–7.
21 Samuelsson S. Chronic cor pulmonale in pulmonary tuberculosis. *Acta Med Scand* 1952;**142:**315–24.
22 Widimsky J, Valach A, Dejdar R, Feffar Z, Bergmann K, Vyslouzil Z, *et al*. Cardiac failure in cor pulmonale due to pulmonary tuberculosis. *Cardiologia (Basel)* 1959;**35:**154–70.