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Original Research Article

Prevalence of rheumatic heart disease among school children of Patna District in Eastern India and an insight into its prevention

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ABSTRACT

Background: Bihar is considered as a 'hot spot' for rheumatic heart disease (RHD). The objective of our study was to determine the prevalence of RHD among school children in Patna district in Bihar.
Methods: We conducted a population-based cross-sectional study in school children of Patna district.
Results: This study estimated that the prevalence of RHD was 1.06 per 1,000 among school children in Patna. None of the factors, including mother's education, father's education, and family income, was a significant risk factor for its causation.
Conclusions: Considering the significant morbidity and mortality it causes, preventive measures at all levels, especially the secondary prevention, must be applied in any region to reduce the disease burden of RHD and its impact on society due to disease severity.

Keywords: Acute rheumatic fever, Valvular heart disease, Morbidity, Secondary prophylaxis

INTRODUCTION

Rheumatic heart disease (RHD) is a preventable but significant health problem in the developing world. Its overall prevalence in the native population has decreased in developed countries over the last three decades; however, it remains a significant concern in the underprivileged population. Surveys conducted among school children in different parts of India, using clinical examination followed by echocardiographic confirmation, estimate a prevalence ranging from 0.7 to 20.4%.[1,2] Low socioeconomic conditions, overcrowding, multiple episodes of sore throat, and genetic predisposition are risk factors for RHD.[3,4] Bihar, a state in the eastern part of India, is considered a 'hot spot' for RHD. Low per capita income and poor health infrastructure could be the contributory factors for significant morbidity and mortality due to RHD in Bihar.[5] Non-compliance with the regular secondary prophylaxis also contributes to an increase in the overall prevalence of RHD and the prevalence of severe rheumatic valvular heart disease. Severe disease can cause disability and premature death if left untreated.[6] The high cost of interventional treatment and cardiac surgery required for significant valvular disease remains unaffordable to many families on their own in the economically backward region like Bihar.[7] RHD causes considerable disability in its severe form, and it led to nearly 10.7 million disability adjusted life years (DALYs) in the year 2019, globally.[8] Detecting this disease in the early stage and ensuring regular secondary prophylaxis in children with acute rheumatic fever (ARF) and RHD, as well as spreading

awareness about this disease among the general public to encourage healthcare seeking, are crucial in reducing the disease burden.[9,10] The objective of this study was to determine the prevalence of RHD in School children of Patna in Bihar district, as no such research has been conducted in Bihar so far.

METHODS

Study design

This study was a population-based cross-sectional study. Children in the 5-17-year age group were examined clinically to look for any evidence of ARF/RHD. Suspected cases were further investigated by echocardiography to look for any evidence of ARF/RHD.

Place of study

This study was conducted at All India Institute of Medical Sciences, Patna. The population based cross sectional study was carried out at various villages of Patna district from November 2021 to August 2023.

Inclusion criteria

Children aged 5-17 years were included in the study.

Exclusion criteria

Children with congenital heart disease, already diagnosed by echocardiography, as per their health records; children with diagnosed valvular heart disease due to etiology other than ARF/RHD, like systemic lupus erythematosus, primary pulmonary hypertension, and pulmonary hypertension due to chronic obstructive pulmonary disease were excluded.

Sample size

Based on published reports, the prevalence of RHD varies from 0.6 to 6 per thousand. Taking 6 per 1,000 as the reported prevalence in India, with a 5% type I error and a 30% margin of error, and assuming a design effect of 1.5 for cluster sampling, the sample size has been estimated to be approximately 10,000. However, due to resource constraints, only 3,781 children could be included in the study and examined clinically from 100 villages across 23 administrative blocks.

Clinical signs used during screening school children for RHD to select them for further investigations by echocardiography included the presence of any murmur in any of the four auscultation areas: mitral, aortic, tricuspid, and pulmonary. 2023 World Heart Federation guidelines for the echocardiographic diagnosis of RHD was used to make diagnosis of RHD.[11]

Statistical analysis

All data were entered into MS Excel 10, and Stata, version 10 (StataCorp, Texas, USA) software was used for the analysis.

RESULTS

A total of 100 villages were surveyed in the rural areas of Patna district in the state of Bihar. The total number of children examined clinically in the 5-17 year age group was 3,781. Out of these 3781 children, males and females were 2214 (58.55%) and 1567 (41.45%) respectively, with a female-to-male ratio of 708 females per 1000 males. The number of children who were suspected to have rheumatic or congenital heart disease based on clinical examinations was 45 (12 per 1000) (Figure 1). An echocardiogram was performed on 44 out of 45 suspected cases. Based on the result of the echocardiogram, 10 children were diagnosed with congenital heart disease, and 04 children were diagnosed with RHD (Figure 2, Table 1). The distribution of RHD cases with various factors is presented in Table 3.

Table 1: Distribution of different types of congenital cardiac lesions.

Cardiac lesion	N (%)
Operated ASD with mild PAH	1 (10)
Mild MR	2 (20)
Operated VSD with infundibular PS with mild residual PS	1 (10)
Large subaortic VSD	1 (10)
Tetralogy of fallot	1 (10)
Small ASD secundum	1 (10)
Operated TOF, severe PS	1 (10)
Large ASD secundum	1 (10)
Bicuspid AV with mild AS	1 (10)
Total	10

Table 2: Distribution of different types cardiac lesions of RHD.

Cardiac lesion	Number
Mild MR	1
Mod. MS	1
Moderate MS, mild MR	1
Mild MS, mild MR	1
Total	4

The overall prevalence of congenital heart disease (CHD) in the study population was 2.64 per 1000 children. Congenital MR was observed in 2 children, making this the most common congenital cardiac lesion in our study (Table 1). The prevalence of congenital heart disease in males was 31.62 per 10,000 male children, and the same was 19.18 per 10,000 female children, indicating a higher prevalence in males as compared to females.

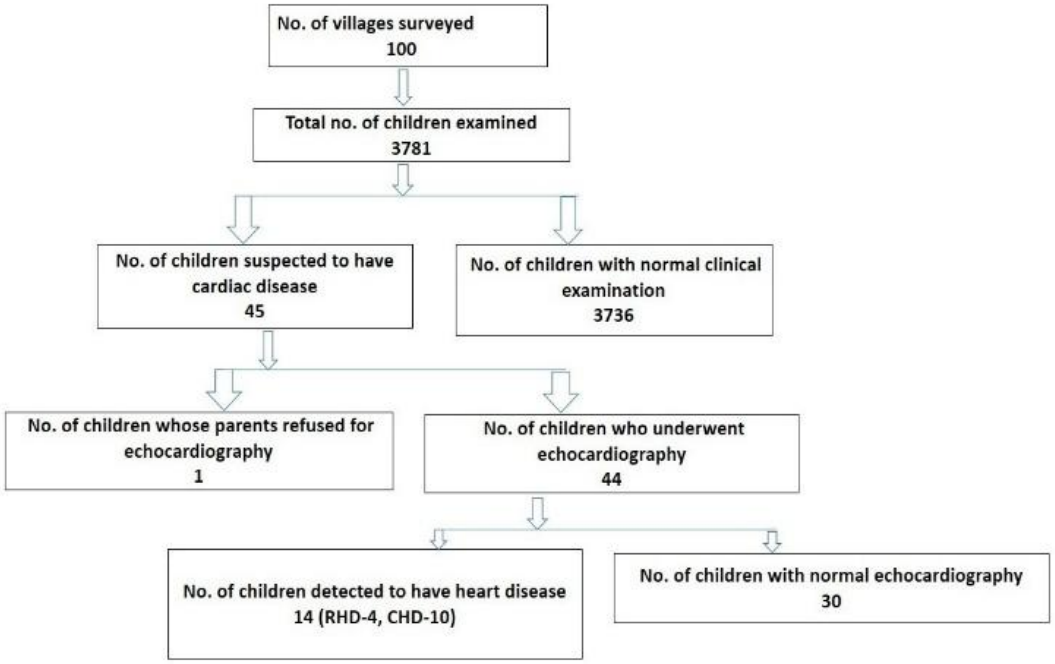

Figure 1: Flowchart of the study showing screening of school children by clinical examination and echocardiography of suspected cases.

Table 3: Socio-demographic characteristics-wise distribution of RHD.

Variables	Diseased	Non-diseased	Crude Odds Ratio	95% Confidence Intervals	Fisher's exact test P-value
Sex					
Male	2	2212	0.71	0.05 - 9.77	0.5496
female	2	1565	Ref.		
Age group (years)					
05-09	0	1790	NA	NA	NA
10-14	4	1669			
15-17	0	318			
Father qualification					
Illiterate	2	649	4.81	0.35 – 66.65	0.1396
Literate	2	3128			
Mother qualification					
Illiterate	2	1475	1.56	0.12 – 21.57	0.5086
Literate	2	2302			
Monthly Income (in Rs.)					
Below Rs. 9226	3	1933	2.86	0.23 – 150.3	0.3307
Above Rs. 9226	1	1844			

NA- Not applicable, Ref-Reference population.

The overall prevalence of RHD was 1.06 per 1,000 among schoolchildren. Mitral valve was involved in all the four cases of RHD (Table 2). The effect of each socio-demographic variable on RHD outcome was assessed using an odds ratio with a 95% confidence interval. The odds of developing RHD in males compared to females were 0.71 (95% CI: 0.05-9.77), but this difference was not statistically significant (p=0.5496). There was no significant association between the father's educational level and RHD (OR=4.81, 95% CI: 0.35–66.65; p=0.1396). There was no significant association between the mother's educational level and RHD (OR=1.56, 95% CI: 0.12-21.57; p=0.5086). The family's monthly income was stratified into two groups: below Rs. 9226 and above Rs. 9226, as the data were sparse in various income categories. The family's monthly income had no significant association with RHD (OR=2.86, 95% CI: 0.23–150.3; p=0.3307). The proportion of RHD

development in the 10–14-year age group was 23.96 per 10,000, and no cases were observed in the 5-9 and 15-17 year age groups.

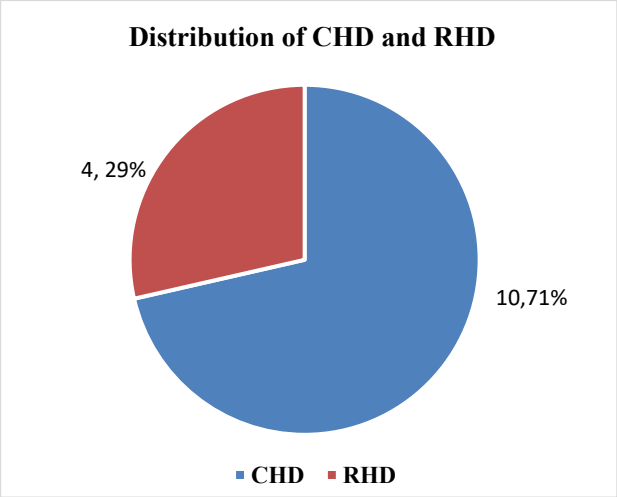

Figure 2: Distribution of CHD & RHD detected after screening of 3781 school children.

DISCUSSION

RHD is a significant health problem among the underprivileged population worldwide. Our study estimated the prevalence of 2.64 and 1.06 per thousand school children for congenital heart disease and RHD, respectively. Considering preventable disease and the amount of morbidity and mortality it causes, a prevalence of RHD of approximately 1 per thousand children is a significant health problem for any region. Various surveys conducted to estimate the prevalence of RHD in school children, using clinical examination followed by echocardiographic confirmation, similar to our study, have estimated RHD prevalence ranging from 0.4 to 1.2/1000 across different states in India. The worldwide age-standardised prevalence is estimated to be 5.1/1000 in 2019.[8] This was 0.9/1000 in high-income countries in Central Europe, Eastern Europe, and Central Asia, and 10.3/1000 in low-income countries, such as those in Sub-Saharan Africa. In South Asia, the pooled prevalence was 2.79 per 1000 (95% Confidence interval (CI): 1.30–4.83) according to studies that used auscultation followed by echocardiography on suspected cases, and 18.28 per 1000 (95% CI: 11.59–26.44) for studies that used echocardiography screening on all participants. The highest prevalence of 8.0 per 1,000 (95% CI: 0.71–22.74) was observed in Pakistan, whereas the lowest prevalence of 0.32 per 1,000 (95% CI: 0.18–0.48) was observed in Bangladesh.[12] Nearly 40.5 million prevalent cases of RHD were identified worldwide in 2019, showing a 1.5- and 1.7-fold increase since 1990. This increase can be attributed to population growth. However, death rates and DALYs attributable to RHD have decreased over the last three decades, presumably due to improvements in healthcare facilities.[13] In our study, there was no difference in the prevalence of RHD between males and females. However, Negi et al described that RHD is more prevalent in females, as per a prospective registry of 2475 ARF/RHD patients. All children with RHD were found to have involvement of Mitral valve in our study. A study by Dass et al described that mitral valve alone is the most commonly affected valve in an estimated 50% to 60% of cases. Combined lesions of both the aortic and mitral valves occur in 20% of cases. Involvement of the tricuspid valve occurs in about 10% of cases but only in association with mitral or aortic disease.[14] Literacy has not been identified as a significant risk factor for RHD in our study. In a study by Prasad et al also, a low level of education was not found to be a statistically significant risk factor for poor awareness of RHD compared to participants with education of 10th standard or above (odds ratio 4.0, 95% CI 0.65-24.24, p=0.15).[6] This is presumably due to a general lack of awareness among the general public with varying levels of literacy. We did not find any significant association between socioeconomic condition and the prevalence of RHD (95% confidence interval 0.23-150.23, p value 0.33), similar to the study by Adanja et al. However, Sharma et al found it to be a significant risk factor for RHD.[15,16]

The high cost of valvular surgeries in patients of RHD who require these, is an important concern in poor states like Bihar, as this is one of the most economically backward states in India. Hence, preventive measures play an important role in controlling RHD in such regions, thereby avoiding costly surgeries. Bihar state has a per capita income of $610 per year, compared to India's average of $2,200 per year.[17] Additionally, 30.6% of the state's population lives below the poverty line, compared to India's average of 22.15%. Advanced stages of rheumatic valvular lesions require cardiac intervention or surgery. The cost of pediatric cardiac surgery has been estimated to be between $ 800 and $ 6,000 USD in India, with the price depending on the type of cardiac surgery.[18] Primary prevention of RHD is a more cost-effective option to prevent this disease, which involves treating streptococcal sore throats with antibiotics to decrease the chances of ARF. Secondary prevention of RHD is achieved through the regular use of antibiotics, most commonly benzathine penicillin. Regular secondary prophylaxis halts the progression of the disease after the first episode of acute rheumatic carditis, and the affected person might not develop valvular heart disease.[19] Torres et al. have found that 41% of patients with ARF may not develop RHD with secondary prophylaxis.[20] Primordial prevention also plays a significant role in the control of ARF and RHD. Primordial prevention of ARF focuses on improving living conditions and reducing poverty to prevent the initial infection with Group A Streptococcus (GAS), which is the trigger for ARF. This approach aims to address the social determinants of health that contribute to ARF risk, such as overcrowding, poor hygiene, and limited access to healthcare.[21] This is supported by the fact that ARF and RHD have been eradicated from the developed world. In contrast, the disease remains endemic in many low- and middle-

income countries (LMICs), with grim health and socioeconomic impacts.[22] Recommended and widely used medication for secondary prophylaxis is injection benzathine penicillin, but it causes significant pain at the injection site, which many children are afraid of. Lidocaine used as a diluent for injection benzathine penicillin has significantly reduced the pain due to injection.[23] Some children who are very apprehensive and reluctant to take the injection benzathine penicillin have been shifted to oral erythromycin for secondary prophylaxis.[6] Gopal et al have found that prophylaxis with once-weekly azithromycin has not been effective in controlling streptococcal colonization of the throat, as compared to twice-daily oral penicillin.[24] Lue et al have found that three weekly injections of benzathine penicillin are more effective in preventing ARF compared to four weekly injections.[25] For secondary prevention, the American Heart Association (AHA) Committee on ARF recommends 1.2 million units of intramuscular injection of Benzathine penicillin every 4 weeks. However, in high-risk situations, administration every 3 weeks is justified and advised.[26] Proper counselling of patients and their attendants regarding the benefits of secondary prophylaxis in preventing further valvular damage is essential for ensuring long-term compliance with regular prophylaxis. Rural residency, lack of money, distance from the health institutions, inaccessibility, poor counselling, forgetting schedules, lack of disease knowledge, and fear of injection pain are the reported factors or reasons for poor adherence.[6,27] Intramuscular benzathine penicillin is more effective than oral antibiotic agents in preventing streptococcal pharyngitis, and its use is associated with a lower incidence of rheumatic fever recurrence.[28] AHA recommendations advise secondary prophylaxis for the longer of 5 years or until the age of 21 for those with ARF without carditis. For ARF and resolved carditis prophylaxis should extend for longer of 10 years or until the age of 21. For those with severe chronic RHD, including after surgical repair or valve replacement, the recommendation is to give prophylaxis for the longer of 10 years or until the age of 40 or lifelong.[29]

Limitations

The sample size is small; therefore, the estimated prevalence may not accurately reflect the actual prevalence and its association with the risk factors. Number of children available for screening per village was less than expected hence sample size became small for this study. We could not further increase the sample size due to the limitation of the funds for this research.

CONCLUSION

RHD continues to be a significant health problem in the developing world. Our study has estimated a RHD prevalence of 1.06 in every 1,000 school children in Patna district. As this causes substantial morbidity and mortality and is often associated with unaffordable surgery in its severe form, preventive measures must be strictly applied to deal with the burden of this disease and to reduce its prevalence further.

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