Original Research Article

Prevalence of Rheumatic Heart Disease Among Children in Bangladesh

ABSTRACT

Aims: The prevalence of Rheumatic Heart Disease (RHD) is estimated to be higher in developing like Bangladesh than in developed countries, ranging from 24/1,000 to 0.3/1,000 respectively. There is no authentic national data since 2005 on prevalence of RHD in our country. Aim of this study is to find out present status of RHD among children in Bangladesh so that government can take further action to strengthen RHD prevention activity.

Methods: A cross-sectional survey of children aged 5–15 years from 20 schools of urban non slum, urban slum and rural area was carried out by a team of cardiologists. Children were screened by clinical examination and diagnosis confirmed by echocardiography. Children who were not willing to enroll in the study and absent students at the day of data collection were excluded from the study. Ethical permission was taken from the institutional review board.

Results: Total 5024 school children aged 5 to 15 years were screened for rheumatic heart disease. Male female ratio was 1.01. Prevalence of RF and RHD were 1.6/1000 and 0.8/1000 respectively. Prevalence of RHD was significantly higher among slum children (3.78/1000) than rural (0.33/1000) and urban children (0.66/1000).

Conclusion: The encouraging observation in our study is a decreasing trend of Rheumatic Fever and Rheumatic Heart Disease in Bangladesh

Keywords: *Rheumatic heart disease, Prevalence, Children, Bangladesh*

1. INTRODUCTION

More than 15 million people worldwide have Rheumatic Heart Disease (RHD) caused by Rheumatic Fever (RF) and nearly a quarter million deaths occurring annually due to this condition [1-4]. RF is the predominant cause of acquired heart disease among children in developing countries [5]. RF is a sequelae of group A beta haemolytic streptococcal sore throat. Without treatment around 3% healthy children develop RF after streptococcal sore throat [2,4] however, in children with a previous history of RF, this risk increases to more than 50% which can be prevented by continuous secondary prophylaxis [6]. Continuous prophylactic antibiotic therapy is the only way to prevent rheumatic recurrence and should be instituted promptly in any patient who has documented RF or RHD [7]. A reduction in the number of RF recurrences with chemoprophylaxis has translated into a reduction in prevalence of RHD [8].

The prevalence of RHD is estimated to be higher in developing than in developed countries, ranging from 24/1,000 to 0.3/1,000, respectively [1,4,9]. It is estimated that 95% of the cases of RHD and deaths related to this disease occur in developing countries [10], moreover, significant costs are associated with the treatment of RHD, including heart valve replacement [11].

RF and RHD still have very highly prevalent and RHD one of the leading causes of premature death and disability of children in Bangladesh. According to data available in National Center for Control of Rheumatic Fever & Heart Disease, Dhaka prevalence of RF/RHD in Bangladesh decline 7.8/1000 to 2.4/1000 from late 1980 to 1993 but still high [12]. Present study is to estimate prevalence of RHD among 5-15 years school children in Bangladesh and can help to take further action for strengthen RHD prevention activity through National Center for Control of Rheumatic Fever & Heart Disease, Bangladesh.

2. MATERIALS AND METHODS

2.1 Study area

Present cross-sectional population-based survey was conducted through National Center for Control of Rheumatic Fever and Heart Disease (NCCRFHD) which has been implementing a comprehensive program for Rheumatic Fever and Rheumatic Heart Disease in Bangladesh. The study was conducted at purposively selected one urban non-slum, one urban slum, and one rural community of Dhaka and Jashore district of Bangladesh. Sher-e-Bangla Nagar Thana (sub district) was selected as an urban non-slum area, Kalyanpur Porabari slum was selected as an urban slum area of Dhaka district, and Dhakuria Union (lowest administrative unit) of Jashore district was selected as a rural area. Twenty educational institutions for children, ten from the rural community, four from the urban slum area, and six from the urban non-slum area, were randomly selected from a list of schools of those respective areas. Data were collected from 1st March to 31st May, 2014, for three months. Total 5024 children aged 5 to 15 years of old from selected schools in urban and rural areas were included in the study. About 60.0% population of Bangladesh live in rural area, so two third of the total sample were from rural area and one third from the urban area.

2.2 Sample

We estimated sample size based on the following assumptions: firstly, the population of Bangladesh at the time of the study was around 140 million (Based on the 2011census with an annual growth rate of 1.4%) and 5-15 years children were approximately 35 million (25% of total population); and secondly, the prevalence of RHD in the population was 7/1000. We calculated that a sample of 5000 children would suffice to measure a prevalence of 0.7% ± 0.25% with 95% confidence. We surveyed all the selected school in each area.

2.3 Survey method

Ten trained research assistants took the interview using a short structured questionnaire during the school to school survey. The trained research assistants undertook the short history, anthropometric measurements that included height (cm), weight (kg) and mid arm circumference (cm) phase by phase. Written consent was taken from selected school authority and from the parents. Socio-

demographic data collected by face-to-face interview with standardized questionnaire. The present and past history of pharyngitis, arthritis/arthralgia, fever, palpitation, fatigue, dyspnea on exertion and chest pain were elicited and recorded in data collection sheet. All the children present in a class at the time of visit examined in one sitting by cardiologist for any murmur in the heart. Particular care was taken in auscultating the child in erect, left lateral and recumbent position. In doubtful cases, children were also auscultated after exercise. Children having positive clinical history for RF and or murmur or abnormal heart sound were selected for laboratory investigation and echocardiography. 5ml blood was collected aseptically from the antecubital vein of those children by a phlebotomist. Blood specimens were immediately stored in a cool box and transported to the laboratory of the National Center for Control of Rheumatic Fever and Heart Disease, Dhaka, on the same day for Complete blood count (CBC), Erythrocyte sedimentation rate (ESR), C-Reactive protein (CRP) and Anti-Streptolysin O (ASO) titer. For rural children echocardiography was done in the department of cardiology, Jashore medical college hospital using GE Vivid 3 Pro cardiac ultrasound machine, 2008 (OSLO, Norway) and for urban children in the National Center for Control of Rheumatic Fever and Heart Disease, Dhaka using Toshiba CC-15M71-MA echocardiographic system, 2006 (Tokyo, Japan) by cardiologist. Acute rheumatic fever was diagnosed using modified Jones criteria.The echocardiographic criteria were agreed by all cardiologists before the scans were performed. Mainly left-sided valves are affected by RF. So we examined left sided valve for features of RHD; mild tricuspid regurgitation and pulmonary regurgitation often seen in normal population, were disregarded. RHD was considered when definite evidence of mitral or aortic valve regurgitation present in two planes by Doppler echocardiography with classical morphological abnormalities of the regurgitant valve like restricted leaflet movement, focal or generalized valvular thickening and abnormal subvalvular thickening [13,14]. Multiple views from thoracic and subcostal area were taken as per recommendations of the American Society of Echocardiography [13,14]. When colour jet seen in at least two views and colour jet length>1 cm then pathological valvular regurgitation was considered. Holosystolic mitral regurgitation and holodiastolic aortic regurgitation were defined when Continuous or pulse-wave Doppler echocardiography revealed velocities exceeding 2.5 m/s.

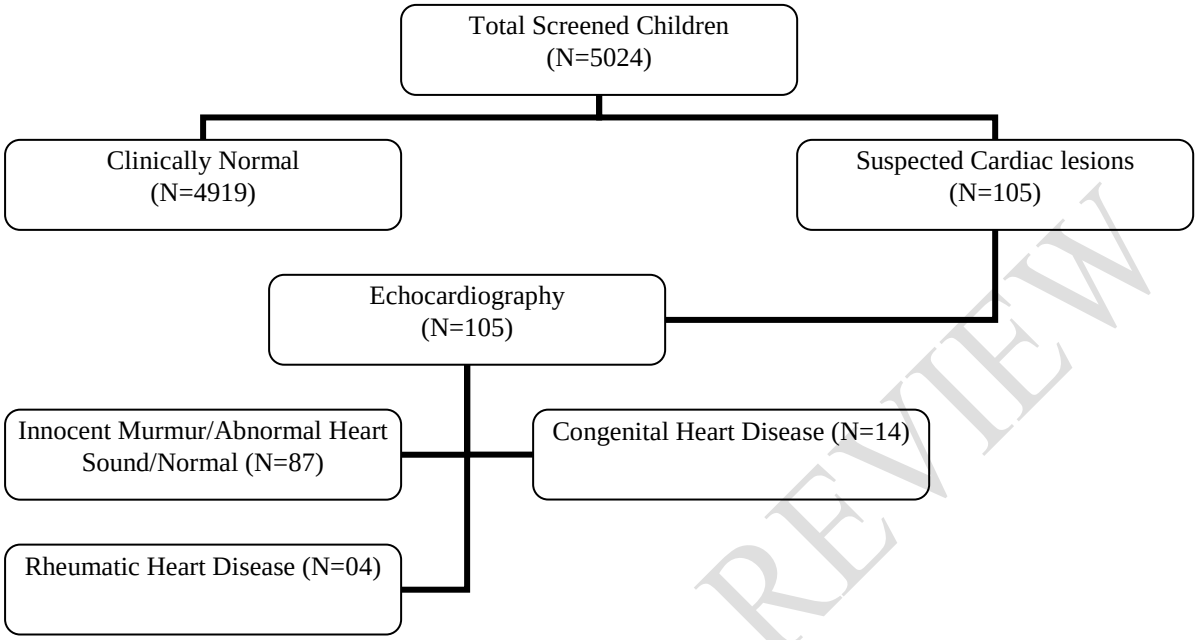
2.4 Ethical Issues

Prior to commencement of study ethical approval was taken from the institutional review board of National Center for Control of Rheumatic Fever and Heart Disease. Formal approval was taken from the school authority for conducting this study in the premises of the institutions. We obtained written consent from the parents or caregivers for their children's participation in this study.

2.5 Statistical method

Data were entered in the computer using SSPS version 16, and the same program was used to perform statistical analysis. All quantitative variables were expressed as mean and standard deviation and categorical variable by frequency and percentage while for qualitative variables, proportions along with 95% confidence intervals were calculated.

FLOW CHART: Result of total screened children at a glance



3. RESULTS

We surveyed 20 schools and a total of 5024 children between the ages of 5 and 15 years. Among them 50.4% were 5-9 years age group and 49.6% were 10-15 years age. 50.3% were male and 49.6% were female. Among the respondents 59.7% were from rural residents, 29.7% were from urban residents and 10.5% were from urban slum area. Of these 5024 children screened, 105 (2.1%) had both symptoms of RF and suspected cardiac lesion brought to the tertiary care hospital for detailed echocardiography and other 4919 (97.9%) were normal. Among the 105 (2.1%) clinically suspected children, 30 (0.6%) had symptoms of RF, 25(0.5%) had loud heart sound and 50 (1%) had murmur. (Table 1)

Table 1: Socio-demographic and clinical characteristics of respondents (n=5024)

Variables	Frequency	Percentage
Age		
5 - 9	2534	50.4
10 - 15	2490	49.6
Gender		
Male	2526	50.3
Female	2498	49.7
Residence		
Rural	3001	59.7
Urban	1494	29.7
Urban slum	529	10.5
Clinical characteristics		
History of symptoms of RF	30	0.6
Normal heart on auscultation	4919	97.9
Abnormal heart sound	25	0.5
Murmur	50	01

*Multiple response

Echocardiography revealed 4 (0.08%) RHD and 14 (0.278%) congenital heart disease (CHD). The prevalence of RHD was therefore, 0.8/1000 (95% CI 0.2 to 2) school children and prevalence of CHD was 2.78/1000 (95% CI 1.5 to 4.7) school children. Location wise prevalence of RHD was 0.33/1000 among rural children, 0.66/1000 among urban non slum children and 3.78/1000 among urban slum children. A history of symptoms of rheumatic fever was elicited from 30 children. From them with the help of modified Jones criteria 8 children were diagnosed Acute Rheumatic fever (RF). The prevalence of RF was therefore 1.6/1000 children (95% CI 0.7 to 3.1). (Table 2)

Table 2: Prevalence rheumatic fever, rheumatic heart disease and CHD

Disease	Frequency	Prevalence	95% CI
Rheumatic fever	8	1.6 /1000	0.7-3.1
Rheumatic Heart Disease	4	0.8/1000	0.2-2
Congenital heart disease	14	2.78/1000	1.5-4.7

Among the RHD cases mitral valve was affected in most cases, with thickened mitral valve in all cases (100%), isolated mitral regurgitation (75%) and a mixed lesion of mitral and aortic regurgitation (25%) was less common. (Table 3)

Table 3: Echocardiographic findings of the patients having rheumatic heart disease (n=4)

Echocardiographic findings	Frequency*	Percentage
MR	3	75.0
MR &AR	1	25.0
Thickened mitral valve	4	100.0

*Multiple responses

Of children with other heart diseases, 14 had CHD. The prevalence of CHD hence was 2.78/1000 children (95% CI 1.5 to 4.7). Most of these had a mild form of the disease. Isolated ventricular septal defect (VSD) was the commonest lesion (42.9%), followed by patent ductus arteriosus (PDA) (35.7%), atrial septal defect (14.3%) and tetralogy of Fallot (7.1%). (Table 4)

Table 4: Distribution of detected congenital heart disease (n=14)

Types of congenital heart disease	Frequency	Percentage
ASD	2	14.3
VSD	6	42.9
PDA	5	35.7
TOF	1	7.1

4. DISCUSSION

This study was carried out to determine the prevalence of RF and RHD among school children aged 5-15 years in rural and urban Bangladesh. Among the 5024 school children were screened 105 had suspected heart disease and they were undergone echocardiographic evaluation. In this study out of 105 clinically probable cases of heart diseases having symptoms and murmur, only 18 cases were found to have heart disease by echocardiography there by indicating low specificity of clinical observation. The role of echocardiography and Doppler ultrasonography as highly sensitive and specific tools in the assessment of RHD have been emphasized in various studies from all over the world [15].

In our target population (5-15 years) of 5024, the prevalence of RHD is 0.8/1000 and prevalence of RF is 1.6/1000 is very low in comparison with previously published report of prevalence of RHD 2.2/1000 in 16 developing countries of 5 WHO regions [16] and previous report 7.5/1000 in 1973 of Malik et al and 2.4/1000 1993 of Begum et al. in Bangladesh [17]. A hospital based study has shown that there has been consistent decline of newly diagnosed RF and RHD cases in NCCRFHD from 1991 to 1997 [18]. Our reported prevalence rate is higher than Zaman et al. a study conducted in 2005 and found prevalence of RHD and RF among school children of Bangladesh respectively 0.3/1000 and 0.6/1000 [28]. But both studies showed prevalence of RF less than 2/1000 and RHD less than 1/1000 indicates Bangladesh now in low risk country for RF/ RHD [27].

Table 5: Prevalence of RHD & RF reported by various studies in Bangladesh

Reference	Study year	Place	Participant age (yrs.)	Prevalence of RHD (Per 1000)	Prevalence of RF (Per 1000)
Malik et al.	1976	Urban	5-15	7.5	
Ahmed et al.	1991	Rural	5-15	1.3	1.2
Haque et al.	1992	Urban & Rural	5-15	2.2	
Joarder et al.	1992	Rural	5-20	1.45	
Mahmud et al.	1992	Urban	5-18	2.8	0.8
Begum et al.	1993	Urban	5-15	2.4	
Zaman et al.	2005	Urban & rural	5-15	0.3	0.6
Present study	2014	Rural & Urban	5-15	0.8	1.6

Our findings also conform to recent trends of RF and RHD in other South Asian countries. A review of studies on prevalence of RF and RHD in developing countries has shown a high prevalence of RF and RHD in the Pacific island countries with a lower prevalence in the Indian subcontinent [19]. Indian studies (having children of similar background as Bangladeshi children) reported prevalence from 1.4 to 2.9 per 1,000 [20,21]. Therefore the low prevalence of RF and RHD observed in our study and the declining trend over several decades may reflect a true underlying trend of RF and RHD in this population.

This finding shows the encouraging observation of decreasing trend of Rheumatic Fever and Rheumatic Heart Disease in Bangladesh. This decline may have several possible explanations. Low education, Poverty, overcrowding, sanitary condition and malnutrition are risk factors for RF and RHD [24, 25]. Over the last three decade substantial social and economic development in Bangladesh has occurred and indicators for human development have shown positive trends [26]. Favorable changes in the socioeconomic conditions and streptococci may be responsible for this declining trend. We speculate that increasing awareness among the people and health professionals, establishment of National Center for Control of Rheumatic Fever and Heart Diseases at Dhaka and providing pediatrician and cardiologists even at rural government hospitals also have contributed.

Prevalence of RHD in urban slum (3.78/1000) was found higher than rural and urban area in this study. Mbenza BL et al showed in a study in Kinshasa town the prevalence of RHD was significantly greater in slums schools (22.2/1000) than in urban school (4/1000) [22]. This is because probably low socioeconomic status, overcrowding, lack of education, economic problem and lack of available health checkup facility in slum area. Mberu et al. showed that the indicators for mortality and morbidity were worse in urban slums than in rural areas in Bangladesh [23].

All Bangladeshi studies used auscultation method to do the primary screening that makes them comparable among themselves but not from other studies. Echocardiographic screening of individuals appears to detect more cases of RHD than auscultation for murmurs [30]. According to a study in Cambodia and Mozambique, approximately 90% of RHD cases detected by echocardiographic screening were clinically silent, without audible murmurs [31]. However concerns have been raised

about the specificity of echocardiography [29]. Cost-effectiveness of such approach to RHD screening also poses a serious question, which is quite relevant to a country like Bangladesh.

5. CONCLUSION

The encouraging observation in our study is a decreasing trend of Rheumatic Fever and Rheumatic Heart Disease in Bangladesh. So rheumatic fever patients need to be educated about secondary prophylaxis. As higher prevalence of RHD in slum area so survey studies needed to identify asymptomatic children of slum area and bring them under coverage of secondary prophylaxis with penicillin. One limitation of our study is that no echocardiography was carried out even in a sample of children without murmur. However, mass clinical screening is more cost effective than echocardiographic screening.

REFERENCES

1. Carapetis JR, McDonald M, Wilson NJ. Acute rheumatic fever. Lancet 2005; 366: 155-68.
2. Gerber MA, Baltimore RS, Eaton CB, Gewitz M, Rowley AH, Shulman ST et al. Prevention of rheumatic fever and diagnosis and treatment of acute Streptococcal pharyngitis: a scientific statement from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee of the Council on Cardiovascular Disease in the Young, the Interdisciplinary Council on Functional Genomics and Translational Biology, and the Interdisciplinary Council on Quality of Care and Outcomes Research: endorsed by the American Academy of Pediatrics. Circulation 2009; 119: 1541-1551.
3. Nordet P, Lopez R, Duenas A, Sarmiento L: Prevention and control of rheumatic fever and rheumatic heart disease: the Cuban experience (1986-1996-2002). Cardiovasc J Afr 2008; 19:135-40.
4. Steer AC, Carapetis JR: Acute rheumatic fever and rheumatic heart disease in indigenous populations. Pediatr Clin North Am 2009; 56:1401-19.
5. Rayamajhi A, Sharma D, Shakya U: First-episode versus recurrent acute rheumatic fever: is it different? Pediatr Int 2009; 51: 269-75.

6. Stewart T, McDonald R, Currie B: Acute rheumatic fever: adherence to secondary prophylaxis and follow up of Indigenous patients in the Katherine region of the Northern Territory. Aust J Rural Health 2007; 15: 234-40.
7. Tompkins DG, Boxer Baum B, Liebman J. Long term prognosis of rheumatic fever patients receiving intramuscular benzathine penicillin. Circulation 1972; 45: 543-51.
8. Lue HC, Tseng WP, Lin GJ, Hsieh KH, Hsieh RP, Chiou JF. Clinical and epidemiological features of rheumatic fever and rheumatic heart disease in Taiwan and the Far East. Indian Heart J. 1983; 35(3): 139-146.
9. Carapetis JR, Currie BJ. Preventing rheumatic heart disease in Australia. Med J Aust 1998; 168: 428-29.
10. Carapetis JR, Mayosi BM, Kaplan EL. Controlling rheumatic heart disease in developing countries. Cardiovasc J S Afr 2006; 17: 164-65.
11. Carapetis JR. Rheumatic heart disease in developing countries. N Engl J Med 2007; 357: 439-41.
12. Jasimuddin Ahmed J, Zaman MM, Hassan MMM. Prevalence of Rheumatic Heart Disease in rural Bangladesh, Trop Doct 2005;35:160-61
13. Reményi B, Wilson N, Steer A, Ferreire B, Kado J, Kumar K et al. World Heart Federation criteria for echocardiographic diagnosis of rheumatic heart disease—an evidence-based guideline. Nat Rev Cardiol 2012; 9: 297–309.
14. Minich LL, Tani LY, Pagotto LT et al. Doppler echocardiography distinguishes between physiologic and pathologic silent mitral regurgitations in patients with rheumatic fever. Clin Cardiol 1997; 20: 924–26.
15. Carapetis J, Hardy M, Fakakovikaetau T, Taib R, Wilkinson L, Penny DJ. et al. Evaluation of a screening protocol using auscultation and portable echocardiography to detect asymptomatic rheumatic heart disease in Tongan schoolchildren. Nat Rev Cardiol 2008; **5:** 411–417
16. WHO cardiovascular disease unit and principle investigator, WHO programme for the prevention of Rheumatic fever / Rheumatic heart disease in 16 developing countries: Report from phase 1 (1986-90). Bull WHO 1992; 70(2): 213-18.

17. Begum UHN, Haque KM, Rouf MA. Clinical profile of RF and RHD in 5-15 years old school children: A school survey report. Paper presented at: Second National Scientific Conference on Rheumatic fever and Rheumatic heart disease; May 29-30, 1993; Dhaka. Bangladesh.
18. Zaman MM, Rouf MA, Haque S. Declining trend of rheumatic fever observed in Bangladesh. Trop Doct.2001; 31:169-170.
19. Saxena A, Ramakrishnan S, Roy A. Prevalence and outcome of subclinical rheumatic heart disease in India: the RHEUMATIC (Rheumatic Heart Echo Utilisation and Monitoring Actuarial Trends in Indian Children) study. Heart. 2011; 97: 2018e2022.
20. Steer AC, Carapetis JR, Nolan TM, Shann F. Systematic review of rheumatic heart disease prevalence in children in developing countries: the role of environmental factors. J Paediatr Child Health. 2002; 38: 229e234.
21. Padmavati S. Rheumatic heart disease: prevalence and preventive measures in the Indian subcontinent. Heart.2001; 86:127.
22. Mbenza BL, Bayekula M, Ngiyulu R, Kintoki VE, Bikangi NF, Seghers KV. Et al. Survey of rheumatic heart disease in school children of Kinshasa town. International Journal of Cardiology 1998; 63 (3): Issue 3, 287-294.
23. Mberu BU, Haregu TN, Kyobutungi C, Ezeh AC. Health and health-related indicators in slum, rural, and urban communities: a comparative analysis. Glob Health Action. 2016; 9:33163.
24. Zaman MM, Yoshiike N, Chowdhury AH, Nakayama T, Yokoyama T, Faruque GM, et al. Nutritional factors associated with rheumatic fever. Journal of tropical pediatrics. 1998; 44 (3): 142–147.
25. Riaz BK, Selim S, Karim MN, Chowdhury KN, Chowdhury SH, Rahman MR. Risk factors of rheumatic heart disease in Bangladesh: a case-control study. Journal of health, population, and nutrition. 2013; 31(1):70–77.
26. Human Development Report: United Nations Development Programme. http://hdr.undp.org/reports/global/2003/ indicator/cty_f_BGD.html Accessed 29.04.06
27. Gewitz MH, Baltimore RS, Tani LY, Sable CA, Shulman ST, Carapetis J, et al. American Heart Association Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease of the Council on Cardiovascular Disease in the Young. Revision of the Jones Criteria for the diagnosis of acute

rheumatic fever in the era of Doppler echocardiography: a scientific statement from the American Heart Association. Circulation. 2015; 131(20):1806-1818.

28. Zaman MM, Choudhury SR, Rahman S, Ahmed J. Prevalence of rheumatic fever and rheumatic heart disease in Bangladeshi children. Indian Heart J. 2015; 67(1): 45-9
29. Roberts K, Colquhoun S, Steer A, Rem_enyi B, Carapetis J. Screening for rheumatic heart disease: current approaches and controversies. Nat Rev Cardiol. 2013; 10: 49e58.
30. Barnes SS, Sim J, Marrone JR *et al*. Echocardiographic screening of schoolchildren in American Samoa to detect rheumatic heart disease: A feasibility study. Pediatr. Health Med. Ther. 2011; 2: 21–3.
31. Marijon E, Ou P, Celermajer DS *et al*. Prevalence of rheumatic heart disease detected by echocardiographic screening. N. Engl. J. Med. 2007; 357: 470–6.