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Echocardiographic screening for rheumatic heart disease: Age matters

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ABSTRACT

Background: Echocardiography is emerging as a screening tool for rheumatic heart disease (RHD) in endemic regions. The vast majority of surveys have been limited to children. We ought to appreciate the interest of including adolescents in their late teens in such school screening programmes.
Methods: School-based echocardiography cross-sectional survey conducted in Dakar, Senegal (March 2010). A total of 2004 school attendees were randomly selected and enrolled in the study, among which 1116 were aged 5–15 years old (group 1), and 888 were 16–18 years old (group 2). Case detection rates and phenotype of RHD were compared according to age groups.
Results: A total of 22 youngsters were suspected by on-site echocardiography, 12 in group 1 and 10 in group 2. Among the 12 RHD cases suspected on-site in group 1, 6 (50%) were eventually considered as confirmed RHD, compared to 9 out of 10 (90%) in group 2, giving prevalence rates of 5.4 (CI 95% 2.0–11.7) and 10.1 (CI 95% 4.6–19.2) per 1000 in group 1 and group 2, respectively. The proportion of marked/advanced lesions was 33% in group 1, and 89% in group 2 ($p = 0.08$). Mean concordance rates between the 3 reviewers were 40% for group 1, compared to 93% in group 2 ($p = 0.05$).
Conclusions: Extension of screening to adolescents in their late teens should be considered with interest in the light of the higher prevalence of the disease and relative clarity of subclinical cardiac lesions that could be more easily detected in the field.

1. Introduction

Rheumatic heart disease (RHD) remains a major health problem in developing countries, affecting the poorest regions, namely sub-Saharan Africa [1–3]. Pathogenesis of the disease involves exposure to group A streptococcus (GAS), abnormal inflammatory response, and susceptibility resulting in the damage of the cardiac valves. RHD is responsible for heart disease in the young, including heart failure and infective endocarditis, and presents a significant burden in women of childbearing age, leading to approximately 250,000 premature deaths per year worldwide [4,5].

Whilst the majority of developing nations consume a vast amount of resources in treating most severe cases that require intervention [6], prevention policies have proven cost-effective, especially secondary prophylaxis within comprehensive programmes [7–9]. To date, active surveillance within efficient register-based control programmes should be one of the major players in controlling the disease [10]. Early detection is paramount to implement secondary prevention and limit the evolution towards severe valve damage [11]. In this context, echocardiography has emerged as a potential tool in high-burden populations [12,13], allowing the detection of subclinical disease as well as the confirmation of clinically audible lesions. RHD prevalence is known to significantly increase with age because of the cumulated effect of repeated exposure to GAS [14].

Most recent screening programmes have focused on young school children up to 14 or 15 years old [15–19]. To date only two studies have included a very small proportion of adolescents over 15 [12,20]. We hypothesized that extending the survey to older teenagers (16–18 years) may be particularly attractive, by increasing the case-detection rates and by easily identifying valve lesions on-site. We therefore conducted a school-based echocardiography cross-sectional survey in Dakar, Senegal, through a large randomized sample from the school community, and

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analysed data according to two groups of different ages (5–15 and 16–18 years).

2. Methods

2.1. Setting and population

We conducted a survey from March 1st to March 31st 2010 in schools from urban and suburban Dakar (2,452,656 inhabitants according to the 2005's census) after approval of the Ethics Committee of the Academy Inspection under the Ministry of Education [21]. Using Epi Info software (version 3.2.2), 4 public schools among primary and middle schools of Dakar and 2 high schools were randomly selected. Only children with informed parental or guardian consent were offered to take part in the study. A total of 2004 children were finally enrolled, among which 1116 were aged 5–15 years (group 1), and 888 were 16–18 years old (group 2).

2.2. Aims of the study

The aim of the study was to evaluate to what degree extending the survey to a population in its late teens (16–18 years old) would increment case-detection rates and modify the presentation of subclinical valve lesions.

2.3. Clinical and echocardiography protocol

All children underwent clinical and echocardiographic examinations at school in a specifically arranged room by the same team (IZ, DD, and AM under the supervision of AK). Echocardiography was performed on-site with portable equipment (Sonos Sonosite MicroMax® using a 3 MHz transducer). When RHD was suspected on-site, a confirmation scan was carried out at the hospital using a non-portable machine (Imagic Agile Kontron®). The confirmation study was recorded for further review by 3 independent experts (OD, ML, and ML) with a positive confirmed RHD case when at least 2 reviewers agreed. Secondary prophylaxis by benzathine penicillin G was started in all positive cases [22].

2.4. Echocardiographic criteria

Definition of echocardiographic features of RHD included the combination of Doppler criteria and at least two mitral valve morphological changes. Doppler criteria were defined as follows: mitral or aortic valve regurgitation was considered significant if seen in at least two planes on colour Doppler, excluding closure jets. Qualitative morphological criteria of the mitral valve included: (i) significant thickening of the valve leaflets either at the tips or through their bodies; (ii) thickening and/or shortening of the mitral subvalvular apparatus; and (iii) mitral valve motion abnormalities as leaflet restriction. Mitral stenosis (MS) was defined as a valve area <2.5 cm^2 by planimetry on the parasternal short axis view. Quantification of left-sided valve disease was undertaken according to current guidelines [23].

Marked RHD (either clinical or subclinical) was defined as moderate or severe mitral or aortic valve disease, and/or multivalvular minimal involvement (i.e., the combination of mitral and aortic valve changes deemed significant), and/or significant valve stenosis (mitral valve area <2.5 cm^2 by planimetry on parasternal short axis view).

2.5. Statistical analysis

All data were entered and analysed using SPSS version 16. Descriptive variables are presented as means $\pm$ SD; sample means were compared with an independent-sample Student's *t*-test. Regarding subclinical cases, mean concordance rates between the 3 reviewers (R1/R2, R2/R3 and R1/R3) were calculated for each group. The exact Fisher test was used to compare the frequencies. Calculation of 95% exact confidence intervals for prevalence was performed. A two-sided *p* value of less than 0.05 was considered to indicate statistical significance. The authors of this manuscript have all certified that they comply with the principles of ethical publishing.

3. Results

Subjects' characteristics, according to groups, are depicted in Table 1, and flow chart of the study in Fig. 1. The mean age was 11.6 ± 2 in group 1, and 17.1 ± 1 in group 2, with a sex ratio (M/F) of 1.3 and 0.9 in groups 1 and 2, respectively.

Twenty-four children (1.2% of the overall population) presented with a murmur thought to be pathological. Among these, 6 cases (25%) were related to organic lesions on echocardiography: 3 to RHD (2 children in group 1, and 1 adolescent in group 2), and 3 to congenital heart disease. In the remaining 18 children, no cardiac abnormality was confirmed on echocardiography.

Echocardiographic screening findings according to age groups are summarized in Table 1 and schematized in Fig. 2. In group 1, 12 suspected RHD cases were detected on-site using portable echocardiography. Six out of these cases (50%) were eventually confirmed after traditional echocardiography and review process giving an overall RHD prevalence of 5.4 (CI 95% 2.0–11.7) per 1000. In group 2, 10 children with suspected RHD were detected on-site using portable

Table 1
Demographic characteristics and phenotype of RHD according to age (groups 1 and 2). Group 1: 5–15 years old; Group 2, 16–18 years old.

	Group 1 *n* = 1116	Group 2 *n* = 888
Age, mean (SD)	11.6 (2.0)	17.1 (1.0)
Gender, male, *n* (%)	622 (55.7)	412 (46.4)
Prevalences		
▪*Prevalence, on-site*, per 1000 (CI 95%)	10.8 (4.7–16.9)	11.3 (4.3–18.3)
▪*Confirmed prevalence*, *n* per 1000 (CI 95%)*	5.4 (2.0–11.7)	10.1 (4.6–19.2)
Proportion of marked lesions, *n* (per 1000)**	2 (1.8)	8 (9.0)
Mean concordance rates (%)***	40	93

* Defined after review of the confirmation hospital-based scan and agreement of at least 2 out of 3 reviewers.
** Defined as moderate or severe left-sided mitral or aortic valve disease, and/or multivalvular minimal involvement (i.e., the combination of mitral and aortic valve changes deemed significant), and/or significant mitral stenosis (valve area <2.5 cm^2 by planimetry on parasternal short axis view).
*** Mean concordance rates between the 3 reviewers (R1/R2, R2/R3 and R1/R3) were calculated for each group.

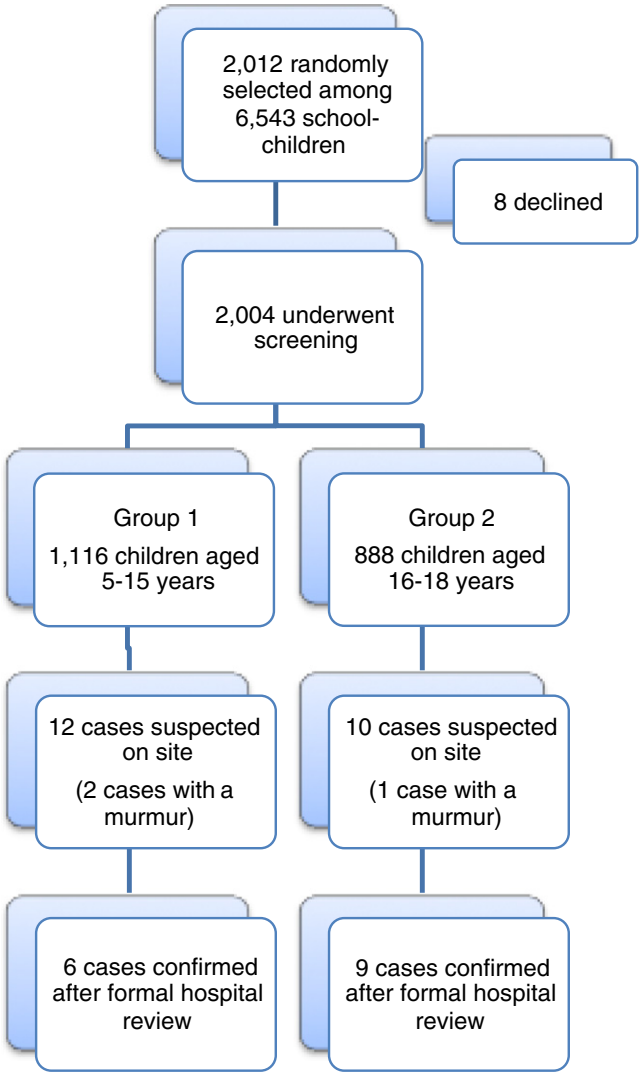

Fig. 1. Flow chart.