

## Echocardiography screening to detect rheumatic heart disease A cohort study of schoolchildren in French Pacific Islands



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### ABSTRACT

**Objective:** The objective of this study is to assess the outcomes of rheumatic heart disease (RHD) diagnosed by means of echocardiography-based screening.

**Methods:** A cohort of children with and with no RHD was driven from a systematic echocardiography-based nationwide surveillance among 4th grade (age 9–10 years) schoolchildren in South-Pacific New Caledonia (2008–2011). The specific follow-up programme used clinical and standardised echocardiography (2012 World Heart Federation criteria) predefined endpoints.

**Results:** Out of the 17,633 children screened, 157 were detected with findings of RHD. Among them, 114 consented children (76.5%) were enrolled (RHD-group), and were compared to 227 randomly selected healthy classmates (non-RHD group). After a median follow-up period of 2.58 years [1.31–3.63], incidence of acute rheumatic fever was similar in RHD and non-RHD groups ( $p = 0.23$ ): 10.28/1000/year and 3.31/1000/year, respectively. By echocardiography, 90 children in the RHD group (78.9%) still presented with RHD at follow-up, compared to 31 (13.7%) in the non-RHD group ( $p < 0.0001$ ). Only 12 children (10.5%) experienced progression of RHD over time, mild single valve disease lesions remaining unchanged in the majority of cases (61 out of 73, 83.6%). Overcrowded living conditions were independently associated with persistent RHD on echocardiography (OR 8.27 95% CI (1.67–41.08),  $p < 0.01$ ). Benzathine penicillin G was given in 88.6% of children in the RHD-group.

**Conclusions:** Children screened positive for RHD by echocardiography have mostly mild but irreversible heart valve disease under secondary prophylaxis. Our findings also suggest that a single screening point in childhood may prove insufficient in high-risk populations.

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### 1. Introduction

Rheumatic heart disease (RHD) is the result of valvular damage caused by an exaggerated immune response to group A streptococcal infections, usually during childhood and adolescence [1]. Although RHD, a disease of poverty, has almost disappeared from wealthy countries [2], its burden remains a major challenge in the developing world and among aboriginal populations in Pacific countries with approximately 345,000 deaths per year worldwide [3–5].

Rheumatic heart disease is still prevalent among Oceanic populations (Melanesians and Polynesians) in New Caledonia, a French overseas territory of 250,000 inhabitants. Unlike other countries, comprehensive

programmes to tackle the burden of disease have proven inefficient so far in the region [6–8]. The World Health Organization has recommended active surveillance in order to initiate secondary prophylaxis early and prevent complications of the disease [9]. Echocardiography-based screening may present an attractive solution, ultrasounds being more sensitive to detect very mild valve lesions [10]. In this setting, the New Caledonians launched an echocardiography-based screening programme aiming at all primary schools (targeting 4th grade) from February 2008.

However, the natural history of echocardiography-detected RHD has never been established and the need for secondary prophylaxis still remains debated [11,12]. There are therefore several unanswered questions in the field, as the outcomes of children screened for RHD, the need for secondary prophylaxis, and the target age-range. We address here the outcomes and modalities of screening through a cohort study of children with and without RHD who took part in the first large RHD echocardiography-based surveillance programme.

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## 2. Methods

### 2.1. Study design and settings

In New Caledonia, active surveillance for RHD by means of ultrasounds was decided as a public health programme in 2007, and conducted in 17,633 schoolchildren in 4th grade (i.e., aged 9–10 years) between February 2008 and November 2011. All children diagnosed with RHD were offered free of charge secondary prophylaxis, yearly echocardiograms, and entered a national register. The aim of the study was to assess the outcomes of children detected by echocardiography as having RHD (RHD group), compared to those without RHD (non-RHD group). In addition, factors associated with persistence or progression of disease were identified.

### 2.2. Participants

Among the 17,633 children screened, 157 were diagnosed with RHD (i.e., presented no history of acute rheumatic fever (ARF) or previously known RHD). One hundred fourteen out of 157 (72.6%) consented to be finally enrolled in the specific follow-up programme, including secondary prophylaxis by oral or injectable penicillin. Among the children with no RHD on echocardiogram between 2008 and 2011, 227 classmates were randomly selected matched according to ethnicity (and classroom) (Fig. 1).

### 2.3. Data collection

For each participant, the following data were collected: demographics (age, sex), place of residence (Province, village), ethnicity, number of siblings, maternal employment, maternal education, housing, number of people living in the household, number of bedrooms, usual mode of transport (car vs. no car), and whether has lived over a year away from

home (either in boarding schools or with other members of the extended family).

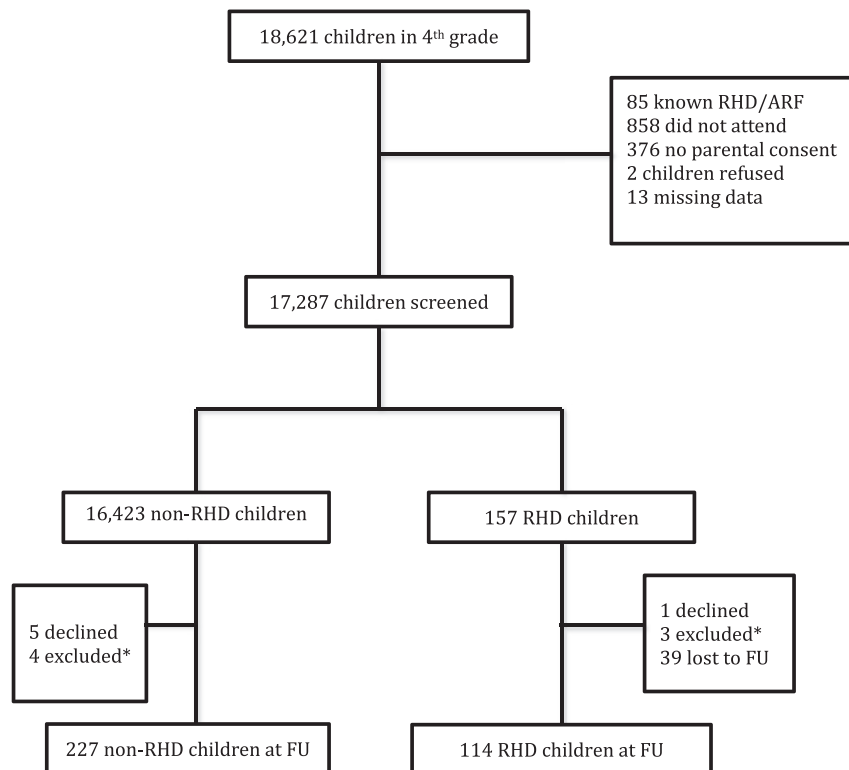
Data on treatment included secondary prophylaxis and its modalities: date of start; drug used (benzathine penicillin G or oral treatment); and periodicity of penicillin injections when applicable.

### 2.4. Echocardiographic protocols

The initial echocardiographic screening protocol comprised two steps. A standardised echocardiography was performed at school in all children who accepted to participate with a written consent from one of the parents (Vivid I, GE®). When an abnormality was suspected, children were invited to attend a second examination by an experienced cardiologist either at one of the practices or during outreach clinics in remote locations. Rheumatic heart disease was diagnosed only on the second scan (baseline echocardiography) according to predefined criteria (Table 1). Briefly, these criteria included a combination of at least two morphological changes of the mitral valve and mitral regurgitation, aortic regurgitation or mitral stenosis. Additional data from the baseline echocardiography were collected in children with RHD: presence and severity of mitral regurgitation, aortic regurgitation and/or mitral stenosis; and left ventricular ejection fraction. Quantification of valve disease was performed according to contemporary guidelines [13].

Follow-up echocardiograms were performed following a standardised protocol (Vivid I, GE®) either at the Agence Sanitaire et Sociale de Nouvelle Calédonie, Nouméa, or at outreach clinics in primary health centres. Rheumatic heart disease diagnosis was based on the World Heart Federation (WHF) criteria following a blinded review of all scans by an experienced cardiologist (MM) [14].

The follow-up scan included: (i) presence and severity of mitral regurgitation, aortic regurgitation, and/or mitral stenosis; [13] (ii) left ventricular ejection fraction; and (iii) detailed WHF criteria [14]. Children who fulfilled quantification requirements for mild (either



**Fig. 1.** Flow chart. School-based screening campaigns between 2008 and 2011 aiming at all children in 4th grade in New Caledonia. Children were followed up from June 2012 to February 2013. RHD, rheumatic heart disease. FU, follow-up. \*Reasons for exclusion: presence of non-RHD lesions at subsequent follow-up (bicuspid aortic valve).

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