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High burden of rheumatic heart disease confirmed by echocardiography among Pacific adults living in New Zealand

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ABSTRACT

Background Despite numerous echocardiographic screening studies of children in high incidence acute rheumatic fever (ARF)/rheumatic heart disease (RHD) communities, little is known about the prevalence of RHD in adults in these populations.

We sought to determine the prevalence of RHD in an urban area of South Auckland, New Zealand, where previous studies had shown the prevalence of RHD in children to be around 2%.

Methods A cross-sectional screening study was conducted between 2014 and 2016. Echocardiography clinics were conducted at an urban Pacific-led primary healthcare clinic in New Zealand. Eligible persons aged 16–40 years were recruited according to a stratified randomised approach. Echocardiograms were performed with a standardised image acquisition protocol and reported by cardiologists.

Results There were 465 individuals who underwent echocardiograms. The overall prevalence of RHD (define and borderline) was 56 per 1000 (95% CI 36 to 78 per 1000). Definite RHD was found in 10 individuals (4 of whom were already under cardiology review at a hospital clinic) with a prevalence of 22 per 1000 (95% CI 9 to 36 per 1000). Non-rheumatic cardiac abnormalities were found in 29 individuals.

Conclusions There is a high burden of both rheumatic and non-rheumatic cardiac abnormalities in this population. Rates described in New Zealand are as high as lower-middle-income countries in Africa. Addressing knowledge gaps regarding the natural history of RHD detected by echocardiography in adults is a priority issue for the international RHD community.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Echocardiographic studies have shown the prevalence of rheumatic heart disease to be around 1% among New Zealand (NZ) Maori children and 2% among Pacific children.

⇒ While there have been numerous echocardiographic rheumatic heart disease (RHD) screening studies among children around the globe, less is known about population-based prevalence of RHD in adults from high-risk populations.

WHAT THIS STUDY ADDS

⇒ We found that 2% or 1 in every 50 Polynesian young adults in South Auckland had definite RHD.

⇒ For every RHD case previously diagnosed by routine clinical services, primary care-based echocardiographic screening detected another case. A further 6% of screened individuals also had non-rheumatic cardiac abnormalities.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Acute rheumatic fever and RHD prevention and control activities in NZ must be targeted at young adults as well as children.

⇒ Portable echocardiography is feasible in primary care clinic settings and may improve access to cardiology services.

BACKGROUND

Rheumatic heart disease (RHD) is a significant global health problem, particularly affecting low-income and lower-middle-income countries, where RHD is estimated to affect over 33 million adults and contribute to over 300 000 deaths annually.[1 2] In 2018, the 71st World Health Assembly unanimously adopted a resolution calling for multisectoral action to accelerate RHD prevention and control activities.[3]

Current estimates of global RHD burden are drawn from numerous echocardiographic screening studies in children[4] along with disease registries and cohort studies describing hospital presentations with severe RHD in high disease burden populations.[5]

There is a paucity of data regarding the prevalence of RHD in adolescents and young adults. Until recently, only a few population-based echocardiographic screening studies have examined adolescents and young adults,[6–10] and these were conducted prior to the publication and subsequent widespread adoption of the World Heart Federation (WHF) consensus diagnostic criteria for RHD in 2012.[11] Two more contemporary studies

in Northern Australia and Timor-Leste have evaluated cohorts which included children and adolescents up to the age of 20 years, using abbreviated imaging protocols.[12 13] The natural history of recurrent acute rheumatic fever (ARF) progressing to chronic RHD is such that the majority of global RHD burden occurs in adults. Knowledge of RHD prevalence and the full spectrum of RHD severity in adults living in high-burden ARF/RHD populations are, therefore, urgently needed to inform prevention and control programmes.

There is a high incidence of ARF and chronic RHD among Polynesian and Māori children and young people in South Auckland, New Zealand (NZ).[14 15] Furthermore, in NZ, there are marked disparities in ARF and RHD burden, with virtually no cases occurring among people of NZ European ethnicity.[16] Māori and Pacific peoples comprise 15% and 7% of NZ's overall population, respectively, and approximately 35% of those under 15 years of age.[17]

In NZ, ARF episodes are recognised to occur in young adults as well as children.[14 18] We hypothesised that the prevalence of RHD in adults would be at least as high as rates seen in a corresponding population of NZ school-aged children where RHD is known to be endemic.

Aims

We sought to determine: (1) the prevalence of RHD in adults in an urban, high-incidence ARF population and (2) The feasibility of portable echocardiographic screening for RHD in an urban primary healthcare setting.

MATERIALS AND METHODS

Study setting

This study was conducted in Otara, South Auckland, at a Pacific-led urban primary healthcare organisation where over 95% of enrolled clinic patients identify as Pacific peoples.

South Auckland, NZ, is an ethnically diverse urban area characterised by high levels of socioeconomic deprivation. The population of approximately 534 000 people is made up of 21% Pacific peoples and 16% NZ Māori.[17]

Participant selection, sample size and randomisation

The study population consisted of young adults aged 16–40 years who were enrolled at a Pacific primary healthcare clinic in Otara, South Auckland. Those who were not resident in South Auckland at the time of the study or who did not have a current address or telephone contact details were deemed ineligible.

Of the 1224 eligible patients, 724/1224 (59%) were female. The median age was 25 years (IQR 20–32 years). Pacific peoples made up 97% of the eligible population. A total of 1010/1224 identified as Samoan, 84/1224 were Tongan, 50/1224 Cook Island Māori, 34/1224 NZ Māori and the remaining 46 were from other Pacific nationalities. A total of 1224 eligible individuals were identified from clinic records and approached using a randomisation scheme.

An a priori power analysis was performed for sample size calculation, based on a known prevalence of definite RHD of around 1% in high-risk NZ children. With an alpha=0.05 and power=0.80, we determined a minimum sample size of 400 individuals would be required to estimate RHD prevalence comparing adults and children in South Auckland. Random numbers were assigned to the 1224 eligible patients, who were then approached by clinic staff in sequential order and invited by telephone and written information pamphlets to participate in the study. Pamphlets and consent forms were provided in Samoan, Tongan and Te Reo Māori and the clinic staff were fluent speakers of Pacific languages.

Enrolment procedures

Eligible individuals were telephoned by the clinic receptionist and invited writing in to attend for an echocardiogram appointment. Echocardiography clinics were undertaken between December 2014 and March 2016.

On arrival to the clinic, the coordinating investigator met with potential participants to discuss the study and written informed consent was obtained. Only 1 person out of the 466 approached declined to participate in the study.

A brief structured questionnaire was administered to ascertain demographic details, personal and/or family history of ARF/RHD, of type 2 diabetes, hypertension, other cardiac diseases and medication history. Where relevant, electronic clinical records were reviewed in order to clarify RHD status and severity for those who reported a history of ARF/RHD.

Height and weight were measured and body mass index (BMI) was calculated.

Echocardiography procedures

Echocardiograms were performed on a Vivid Q (GE, General Electric Corporation, Chicago, Illinois, USA) portable platform with a 3S 2.2 MHz transducer by highly experienced cardiac sonographers. Images were acquired and reported using standardised protocols previously used in NZ by this group of investigators.[15 19]

Two-dimensional and colour Doppler images were obtained in parasternal and apical views, with multiple colour sweeps of any mitral or aortic regurgitant jets identified. Pulse-wave Doppler interrogation of regurgitation jets was performed to assess peak velocity, duration through the cardiac cycle and spectral envelope. Valve leaflet morphology and thickness were assessed in parasternal long axis (mitral and aortic) and parasternal short axis views (aortic valve) using previously described methods.[20] Images were electronically stored in Digital Imaging and Communications in Medicine format.

Left ventricular size and function were assessed by M mode. Additional images were obtained at the discretion of the sonographer.

Echocardiograms were reviewed by one investigator (NC-S) and studies showing any potential abnormalities were then reported by a panel of cardiologists (NJW, JS, TLG and RD), blinded to the participant's demographic details and clinical history. RHD findings were classified as definite or borderline RHD according to WHF diagnostic criteria for RHD.[11] Two cardiologists reviewed all potentially abnormal echocardiograms, with a third cardiologist called in to adjudicate in the event of a disagreement.

Non-rheumatic echocardiographic abnormalities were interpreted in the context of available clinical information and clinical follow-up recommendations were made by an adult cardiologist (RD).

Participant follow-up

Individuals with abnormal echocardiograms were invited to return to discuss results and follow-up recommendations with a study doctor (NC-S and RW). Participants were then referred to their primary care provider doctor or hospital cardiology services as appropriate. Benzathine penicillin secondary prophylaxis was recommended for the following groups: definite RHD <21 years, definite RHD >21 years if severe/post-RHD surgery, borderline RHD with strong family history of ARF/RHD <21 years.

Statistical methods

Overall RHD prevalence was calculated by the sum of clinically detected cases and those newly detected by echocardiography.

RHD prevalence was reported per 1000 population, with 95% CIs calculated for proportions. Statistical analyses were performed on SAS V.9.1.3 (SAS Institute).

RESULTS

Demographics of study population

A total of 465 individuals were recruited and underwent echocardiography, representing 38% of the total 1224 eligible young adult patients enrolled at the clinic. Median age of those undergoing echocardiography was 28.0 years (IQR 20.7–34.9 years). Sixty-four per cent were female. Ninety-nine per cent of participants (460/465) identified as Pacific peoples. A total of 364 (78.3%) self-identified as Samoan, 44 (9.5%) were Tongan, 18 (3.9%) were Cook Islanders, 15 (3.2%) were NZ Māori 15 and 10 (2%) were Niuean.

Clinical history of ARF/RHD

Among the 465 individuals who underwent echocardiography, 8 (1.7% of the screened cohort) self-reported a history of ARF/ RHD. Of these eight, two were receiving regular benzathine penicillin injections and two had previously undergone heart valve surgery for RHD.

Family history of ARF/RHD was reported in 56/465 individuals (12%) and 31/465 (7%) reported a first-degree relative with ARF/RHD.

Table 1 Prevalence of RHD detected by echocardiography in Polynesian young adults

RHD category	No	Prevalence (95% CI)
RHD definite*	10 (5 F, 5 M)	22 per 1000 (9 to 36)
RHD borderline (<20 years)	16 (8 F, 8 M)	34 per 1000 (19 to 52)
RHD borderline+definite	26 (13 F, 13 M)	56 per 1000 (36 to 78)

Four previous ARF cases with normal echocardiograms not included in RHD prevalence.
*Six newly detected RHD cases, four clinically diagnosed RHD cases confirmed by echocardiography.
ARF, acute rheumatic fever; RHD, rheumatic heart disease.

Comorbidities

Type 2 diabetes or pre-diabetes was reported by 33/465 (7%) of the cohort and 21/465 (4.5%) had hypertension.

Significant non-rheumatic cardiac disease occurred in four individuals (cardiac ablation procedure for Wolff-Parkinson-White syndrome, atrial myxoma surgery, non-ST elevation myocardial infarction, infective endocarditis).

The median BMI of participants was in the obese range. The median BMI of female participants was 35.3 (IQR 30.6–40.9) and the median BMI of male participants was 33.2 (IQR 27.1–38.9).

Echocardiographic prevalence of RHD

The overall prevalence of RHD (definite and borderline) was 56 per 1000 (95% CI 36 to 78 per 1000). Definite RHD was found in 10 individuals (4 of whom were already under cardiology review at a hospital clinic) with a prevalence of 22 per 1000, and Borderline RHD was found in 16 individuals <20 years of age (see table 1).

Detailed description of valvular abnormalities

Among the 10 individuals with definite RHD, there were 5 females and 5 males. There was a wide spectrum of findings and disease severity. Five individuals had mixed disease involving the mitral and aortic valves (see table 2).

Of the eight individuals who reported a history of previously diagnosed ARF/RHD, three had normal echocardiograms, one had borderline RHD and four had definite RHD.

RHD clinical management and outcomes

Eight patients with RHD were referred to hospital cardiology clinics. Four individuals who were young, or with severe RHD and/or family history commenced BPG secondary prophylaxis as a result of participation in this study, as per NZ clinical guidelines for ARF diagnosis and management.[21]

There were 11 individuals with non-rheumatic abnormalities who were referred to hospital cardiology clinics for further evaluation, on the recommendation of the study cardiologist.

Table 2 Clinical features of study participants with definite RHD

	Demographics	RHD details	Clinical management
New diagnosis RHD	Female, 29 years	Mild pathological MR, rheumatic MV morphology*	Referred to GP for follow-up BPG not recommended in view of mild disease and age
	Female, 23 years	Mild pathological AR, mild-to-moderate MS and MR	Referred to cardiology clinic for consideration of BPG Patient lost to follow-up (incarcerated)
	Male, 37 years	Mild pathological MR, mild pathological AR, rheumatic morphology* both valves	Referred to cardiology clinic BPG not recommended in view of age and mild disease
	Male, 20 years	Moderate to severe AR, rheumatic morphology* AV	BPG recommended and commenced Referred to cardiology clinic
	Female, 20 years	Rheumatic morphology* MV, mild MR	Initial counselling by study team then did not return to primary health clinic or hospital appointment
	Male, 16 years	Moderate AR, rheumatic AV morphology*	BPG recommended and commenced Referred to cardiology clinic
Previously diagnosed RHD	Male, 39 years	3 years post St Jude MVR, on warfarin but not BPG, clinic attender	BPG not recommended in view of age
	Female, 19 years	12 years post-AV repair and MV replacement, brother with ARF, receiving regular BPG injections in primary care but was lost to hospital clinic follow-up	Rereferred to cardiology clinic
	Female, 35 years	Moderate AR, typical morphological features* of AV and MV, already attending cardiology clinic and receiving BPG prophylaxis	No further action
	Male, 28 years	Moderate-to-severe MS moderate AR, morphological features* on AV and MV, poor clinic attendance, not on BPG	Rereferred to cardiology clinic BPG recommended and commenced

*Morphology indicates at least two rheumatic valvular morphological features as per 2012 WHF criteria.
AR, aortic regurgitation; AV, aortic valve; BPG, benzathine penicillin G; GP, general practitioner; MR, mitral regurgitation; MV, mitral valve; MVR, mitral valve replacement; WHF, World Heart Federation.

Prevalence of non-rheumatic echocardiographic abnormalities

Non-rheumatic echocardiographic abnormalities were identified in 29/465, 62 per 1000 (95% CI 33 to 73 per 1000) comprising: left ventricular hypertrophy with or without impaired function (n=12), mild structural variations of the mitral valve (including congenital prolapse) without other features of RHD (n=6), dilated aortic outflow tract (n=4), right heart dilatation (n=2), annular calcification (n=1), septal hypertrophy or hypokinesis (n=3) regional wall abnormality (n=1).

DISCUSSION

Key findings

This study describes RHD prevalence in Polynesian adults living in an urban environment and high-income country and is also one of only a few publications to describe RHD prevalence in adults using the internationally accepted WHF diagnostic criteria.[22 23] Our study, thus, addresses important knowledge gaps around burden of RHD in adults from high incidence ARF populations.

Among the screened cohort of 465 young adults, 5.6% had features of RHD on echocardiography and 2.2% met WHF criteria for definite RHD. In other words, up to 1 in 50 young adults of Pacific ethnicity in South Auckland may be living with RHD. These are disturbingly high rates, but are in keeping with the 1:150 incidence of ARF in NZ children living in socioeconomic deprivation[14] and the high prevalence of RHD previously reported in NZ Pacific children.[15 24]

Four (0.9%) of the cohort of 465 individuals who underwent echocardiography also had a prior history of clinically diagnosed RHD. For every definite RHD case previously identified through routine clinical care pathways, echocardiographic screening detected an additional case of definite RHD.

Severity and clinical significance

The prevalence and severity of RHD described in this population is higher than reported in many other endemic RHD regions, even accounting for less stringent diagnostic criteria in earlier studies. Only in Uganda has adult RHD prevalence been described in adults using WHF criteria. Scheel *et al* found a similar prevalence rate of approximately 20 per 1000, however, disease severity was substantially lower in Uganda as compared with

Table 3 Echocardiographic studies of RHD prevalence in adolescents and adults

Study setting	Patient characteristics	RHD prevalence definite	RHD prevalence borderline	Comments
Studies using WHF 2012 consensus diagnostic criteria				
South Auckland, New Zealand, urban Polynesian	465 individuals Age range 16–40 years Median age 28.0 years (IQR 20.7–34.9 years)	22 per 1000 (9, 36) 10 individuals with RHD 7/10 had moderate or severe disease	34 per 1000 (19, 52)	
Ethiopia, rural[10]	987 individuals Age range 6–25 years Median age 13.2±4.7 years	60 per 1000, 16–20 years old 11 per 1000, 21–25 years old		Detailed age breakdown of participants not stated
Uganda, rural[12]	983 individuals >20 years old Mean age overall 20.0±11.9 years	In 21–30 years old, 20 per 1000 In 31–40 years old, 15 per 1000 19/23 adults had mild disease		Detailed age breakdown of participants not stated
Australia and Timor-Leste[13]	3111 individuals ≤20 years old Median age 12 years	3.2% definite RHD all ages		
Australia and Timor-Leste[23]	3329 individuals ≤20 years old Median age 12 years 730 16–20 years	3.2% 16–20 years old	2.2% 16–20 years old	
Studies using other diagnostic criteria for RHD				
New Caledonia, mixed rural/town[7]	834 individuals Age range 18–22 years Mean age 20.0±1.5 years 65% Pacific ethnicities (Melanesian/Polynesian)	5.9 per 1000 (95% CI 2.6 to 12.2 per 1000) overall 9.7 per 1000 in Pacific peoples	1.8%	3.4% reported to have non-rheumatic disease
Senegal, urban and suburban[31]	888 individuals 16–18 years Mean age 17.1±1 year	10.1 per 1000 (95% CI 4.6 to 19.2 per 1000 8 of 9 cases had severe RHD		In 6–15 years prev=5.4 per 1000
Nicaragua, urban/rural[6]	489 adults 20–35 years Median age 26.8 years	22 per 1000 10 of 11 cases were female		27 per 1000 non-rheumatic disease
Eritrea, urban[32]	348 pregnant women Age range 15–42 years Mean age 26.9 years Conducted in 2008	23 per 1000 (95% CI 7 to 39 per 1000)	8 borderline cases	
China, urban and suburban[8]	8080 individuals Conducted in 2001–02	1.8 per 1000 15 found to have RHD		

RHD, rheumatic heart disease; WHF, World Heart Federation.

South Auckland, NZ (see table 3).[22] Seven out of 10 individuals with definite RHD in our cohort had RHD graded as moderate or severe and 2 (0.4%) had previous RHD surgery.

Our findings contribute to improved understanding of the clinical significance and natural history of RHD. We found a higher prevalence of definite RHD in young adults (2%) as compared with schoolchildren (1%) using WHF criteria[24] in keeping with ARF epidemiology in NZ, where ARF cases are reported in adolescents and young adults in addition to schoolchildren.[16] Our finding that RHD prevalence in adults was modestly higher than childhood rates, coupled with the observation that four individuals with a prior clinical diagnosis of ARF/RHD had normal follow-up echocardiograms, highlights that RHD may take a variable course over time and may progress, remain stable or improve.[25–27]

We have reported borderline RHD prevalence strictly in accordance with the WHF criteria, which do not include a borderline RHD category for adults aged over 20 years; our findings are an important addition to the emerging data of the natural history of echocardiographically detected RHD and highlight a future research priority in high-risk populations where echocardiographic screening programmes are under consideration. Future longitudinal follow-up studies of adults >20 years with borderline RHD features would help to clarify the clinical significance of these findings and inform clinical practice guidelines for this group of individuals.

Non-rheumatic abnormalities

Use of a detailed echocardiographic protocol by experienced cardiac sonographers using high-quality portable machines, together with specialist cardiology review of

all echocardiograms and blinded assessment by multiple reviewers for those with suspected abnormalities, enabled careful and unbiased evaluation for both rheumatic and non-rheumatic abnormalities. Overall, 12% of the cohort was found to have echocardiographic abnormalities, with similar proportions of rheumatic and non-rheumatic abnormalities (5.5% and 6.2%, respectively). High rates of non-rheumatic changes, particularly left ventricular dysfunction, are consistent with an echocardiographic study conducted in NZ Māori.[28] Likely contributing factors include the high prevalence of non-communicable diseases (NCDs) including type 2 diabetes, obesity and hypertension in NZ Pacific and Māori populations.

Similarly high prevalence of non-rheumatic cardiac abnormalities could be anticipated in other resource-limited settings where RHD and high NCD burden coexist. To date, non-rheumatic abnormalities have only been described in a new Caledonian RHD screening study, where a similar spectrum of abnormalities to those found in NZ were noted,[7] and more recently, in Northern Australia and Timor-Leste, where the prevalence of congenital abnormalities was around 2%.[12 13] This may be due to limited capacity for detailed echocardiography reporting by expert cardiologists in many settings where RHD echocardiographic studies have been conducted. Programmes designed to detect RHD may not recognise non-rheumatic cardiac abnormalities. Our findings also emphasise the importance of considering RHD control alongside other NCD programmes in resource-limited settings.

Primary care setting

This study demonstrates the feasibility of echocardiographic RHD case detection in a primary care setting and we believe this is the first study of its kind to be conducted within an urban primary care clinic. Ease of access to community-based echocardiography enabled individuals to participate and attendance at hospital was not required. Individuals with a clinical diagnosis of ARF/RHD who had previously defaulted from follow-up were also provided with an opportunity to re-engage with clinical care. The primary care-based study setting also enabled participants with cardiac abnormalities to be linked seamlessly back to their primary care physician for ongoing care and follow-up.

Secondary prophylaxis of RHD in adults

There is currently a lack of consensus in international guidelines relating to recommendations around the initiation and duration of secondary prophylaxis for adults with newly diagnosed RHD, detected by either clinical means or echocardiographic screening (see table 4). Variable practice regarding continuation of secondary prophylaxis in adults, has recently been described amongst a cohort of adults ≥35 years in the Northern Territory of Australia. [29] The decreasing risk of ARF with increasing age in adults is an ongoing conundrum for secondary prophylaxis recommendations in those with mild RHD.

Understandably, the main focus of ARF diagnosis and management guidelines is to provide guidance regarding diagnosis and threshold for initiation of secondary penicillin prophylaxis for patients who are diagnosed with ARF or RHD after presenting with clinical signs and symptoms,[30] as opposed to the minority who are diagnosed via echocardiographic screening. In our study, treatment recommendations were made on a pragmatic and individualised basis. Secondary prophylaxis was initiated in four individuals with definite RHD including younger adults <21 years, older adults with severe disease and those with a strong family history of ARF/RHD. Other adults in whom prophylaxis may be warranted

Table 4 Recommendations regarding secondary penicillin prophylaxis for adults with ARF/RHD

Guideline	Initiation of secondary prophylaxis for ARF and RHD in children	Initiation of secondary prophylaxis for adults with newly diagnosed RHD	Duration of prophylaxis for severe RHD
Australia[33]	Minimum 10 years of until age 21 years, whichever is longer	If >25 years at RHD diagnosis, for 10 years until age 35 years then reassess	Age 40 or longer
New Zealand[21]	If >21 years at ARF diagnosis and no carditis, consider discontinuing after 5 years ARF with carditis—minimum 10 years, or until age 21 years, whichever is longer	Individualised approach depending on age at RHD diagnosis, severity, age of any suspected prior attach, risk of exposure to GAS	Moderate—age 30 Severe—age 40, reassess at 30 depending on individual circumstances
India[34]	No carditis—5 years or until 18 years of age—whichever longer Mild/moderate carditis—10 years or age 25, whichever longer	Resolved carditis—10 years since last attack or age 25, whichever longer	Lifelong, with review age 40 years
WHO[35]	No carditis—5 years since last attack or 18 years of age, whichever longer Carditis—10 years since attack or 25 years of age, whichever longer	Resolved carditis—10 years since last attack or age 25, whichever longer	Lifelong for moderate-to-severe and RHD surgery

ARF, acute rheumatic fever; GAS, group A Streptococcus; RHD, rheumatic heart disease.

include parents of young children and school teachers who are likely to be exposed to group A Streptococcus, and women in childbearing years where progression of RHD confers increased risk of pregnancy complications.

Potential limitations

Seven per cent of the screened cohort reported a family history of ARF/RHD in a first-degree relative. While it is possible that individuals with a family history of ARF/RHD may have been more motivated to participate in this study, selection bias was mitigated by use of a consistent randomisation approach to recruit participants. Furthermore, the age, gender and ethnic make-up of those who underwent echocardiography were broadly very similar to the overall eligible patient population enrolled at the clinic. Our findings reflect RHD prevalence in an urban NZ setting of high socioeconomic deprivation and household crowding, and as such may not be generalisable to other settings in NZ or the Pacific Islands. The high BMI of many individuals in this cohort meant echocardiographic image acquisition was technically challenging, which may have led to an underestimation of the true burden of RHD.

Research in context

Evidence before this study

Since the mid-2000s, numerous echocardiographic screening studies have improved understanding of the global prevalence and spectrum of RHD. To date, these studies have focused almost entirely on paediatric populations. Few published studies have described RHD prevalence in adults according to internationally accepted WHF consensus diagnostic criteria. The prevalence of definite RHD in indigenous Māori and Polynesian children using the WHF criteria in NZ is around 1%, however, the prevalence of RHD in adults in NZ is unknown.

Added value of this study

This study found that 2% or 1 in every 50 Polynesian young adults in South Auckland had definite RHD. For every RHD case previously diagnosed by routine clinical services, primary care-based echocardiographic screening detected another case. A further 6% of screened individuals also had non-rheumatic cardiac abnormalities. NZ is a high-income country, but RHD prevalence in Polynesian young adults living in urban South Auckland is as high as Africa. The majority of RHD cases had moderate or severe disease, highlighting major deficiencies in existing healthcare services for underserved and socioeconomically deprived populations in NZ.

Implications of all the available evidence

ARF and RHD prevention and control activities in NZ must be targeted at young adults as well as children. Addressing knowledge gaps regarding the burden and natural history of echocardiographically detected RHD in adults (including those with borderline changes) is a priority issue for the international RHD community.

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Contributors RW and NJW conceived and designed the study. RW contributed to data acquisition, analysis and led writing of the study report. NC-S and ET led data acquisition and analysis and critically reviewed the report NJW, JS, TLG and RD reported study echocardiograms, provided expert cardiology advice and critically reviewed the report. BP contributed expertise in adult RHD management and critically reviewed the manuscript. AC contributed expertise in Pacific primary healthcare to the study design, facilitated data acquisition and critically reviewed the manuscript. RW is the overall guarantor for the study.

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REFERENCES

1 Roth GA, Mensah GA, Johnson CO, *et al*. Global burden of cardiovascular diseases and risk factors, 1990-2019: update from the GBD 2019 study. *J Am Coll Cardiol* 2020;76:2982–3021.
2 Watkins DA, Johnson CO, Colquhoun SM, *et al*. Global, regional, and national burden of rheumatic heart disease, 1990-2015. *N Engl J Med* 2017;377:713–22.
3 White A. WHO resolution on rheumatic heart disease. *Eur Heart J* 2018;39:4233.
4 Rothenbühler M, O'Sullivan CJ, Stortecky S, *et al*. Active surveillance for rheumatic heart disease in endemic regions: a systematic review and meta-analysis of prevalence among children and adolescents. *Lancet Glob Health* 2014;2:e717–26.
5 Zühlke L, Karthikeyan G, Engel ME, *et al*. Clinical outcomes in 3343 children and adults with rheumatic heart disease from 14 low- and middle-income countries: two-year follow-up of the global rheumatic heart disease registry (the remedy study). *Circulation* 2016;134:1456–66.
6 Paar JA, Berrios NM, Rose JD, *et al*. Prevalence of rheumatic heart disease in children and young adults in Nicaragua. *Am J Cardiol* 2010;105:1809–14.

7 Ledos P-H, Kamblock J, Bourgoin P, *et al*. Prevalence of rheumatic heart disease in young adults from new caledonia. *Arch Cardiovasc Dis* 2015;108:16–22.
8 Zhimin W, Yubao Z, Lei S, *et al*. Prevalence of chronic rheumatic heart disease in Chinese adults. *Int J Cardiol* 2006;107:356–9.
9 Aliku T, Sable C, Scheel A, *et al*. Targeted echocardiographic screening for latent rheumatic heart disease in northern Uganda: evaluating familial risk following identification of an index case. *PLoS Negl Trop Dis* 2016;10:e0004727.
10 Gemechu T, Mahmoud H, Parry EH, *et al*. Community-based prevalence study of rheumatic heart disease in rural ethiopia. *Eur J Prev Cardiol* 2017;24:717–23.
11 Reményi B, Wilson N, Steer A, *et al*. World Heart Federation criteria for echocardiographic diagnosis of rheumatic heart disease -- an evidence-based guideline. *Nat Rev Cardiol* 2012;9:297–309.
12 Francis JR, Whalley GA, Kaethner A, *et al*. Single-view echocardiography by nonexpert practitioners to detect rheumatic heart disease: a prospective study of diagnostic accuracy. *Circ Cardiovasc Imaging* 2021;14:e011790.
13 Francis JR, Fairhurst H, Yan J, *et al*. Abbreviated echocardiographic screening for rheumatic heart disease by nonexperts with and without offsite expert review: a diagnostic accuracy study. *J Am Soc Echocardiogr* 2023.
14 Milne RJ, Lennon DR, Stewart JM, *et al*. Incidence of acute rheumatic fever in New Zealand children and youth. *J Paediatr Child Health* 2012;48:685–91.
15 Webb RH, Wilson NJ, Lennon DR, *et al*. Optimising echocardiographic screening for rheumatic heart disease in New Zealand: not all valve disease is rheumatic. *Cardiol Young* 2011;21:436–43.
16 Gurney J. The incidence of acute rheumatic fever in New Zealand, 2010-2013. *N Z Med J* 2015;128:65–7.
17 Statistics New Zealand. Census of population and Dwellings Wellington. 2013. Available: www.statistics.govt.nz
18 Dennison A, Peat B, Wilson E, *et al*. Rheumatic fever recurrences in New Zealand 2010-14. *N Z Med J* 2020;133:47–57.
19 Webb RH, Gentles TL, Stirling JW, *et al*. Valvular regurgitation using portable echocardiography in a healthy student population: implications for rheumatic heart disease screening. *J Am Soc Echocardiogr* 2015;28:981–8.
20 Webb RH, Culliford-Semmens N, Sidhu K, *et al*. Normal echocardiographic mitral and aortic valve thickness in children. *Heart Asia* 2017;9:70–5.
21 Heart Foundation of New Zealand. New Zealand guidelines for rheumatic fever: diagnosis, management and secondary prevention of acute rheumatic fever and rheumatic heart disease: 2014 update. n.d. Available: www.heartfoundation.org.nz
22 Scheel A, Ssinabulya I, Aliku T, *et al*. Community study to uncover the full spectrum of rheumatic heart disease in Uganda. *Heart* 2019;105:60–6.
23 Beaton A, Okello E, Scheel A, *et al*. Impact of heart disease on maternal, fetal and neonatal outcomes in a low-resource setting. *Heart* 2019;105:755–60.
24 Culliford-Semmens N, Nicholson R, Tilton E, *et al*. The world heart federation criteria raise the threshold of diagnosis for mild rheumatic heart disease: three reviewers are better than one. *Int J Cardiol* 2019;291:112–8.
25 Rémond M, Atkinson D, White A, *et al*. Are minor echocardiographic changes associated with an increased risk of acute rheumatic fever or progression to rheumatic heart disease? *Int J Cardiol* 2015;198:117–22.
26 Engelman D, Wheaton GR, Mataika RL, *et al*. Screening-Detected rheumatic heart disease can progress to severe disease. *Heart Asia* 2016;8:67–73.
27 Beaton A, Okello E, Rwebembera J, *et al*. Secondary antibiotic prophylaxis for latent rheumatic heart disease. *N Engl J Med* 2022;386:230–40.
28 Whalley GA, Pitama S, Troughton RW, *et al*. Higher prevalence of left ventricular hypertrophy in two Māori cohorts: findings from the hauora manawa/community heart study. *Aust N Z J Public Health* 2015;39:26–31.
29 Holland JV, Hardie K, de Dassel J, *et al*. Rheumatic heart disease prophylaxis in older patients: a register-based audit of adherence to guidelines. *Open Forum Infect Dis* 2018;5:ofy125.
30 Gewitz MH, Baltimore RS, Tani LY, *et al*. 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;131:1806–18.
31 Kane A, Mirabel M, Touré K, *et al*. Echocardiographic screening for rheumatic heart disease: age matters. *Int J Cardiol* 2013;168:888–91.
32 Otto H, Saether SG, Banteyrga L, *et al*. High prevalence of subclinical rheumatic heart disease in pregnant women in a developing country: an echocardiographic study. *Echocardiography* 2011;28:1049–53.
33 RHDAustralia (ARF/RHD writing group). *The 2020 Australian guideline for prevention, diagnosis and management of acute rheumatic fever and rheumatic heart disease*. 2022.
34 Working Group on Pediatric Acute Rheumatic Fever and Cardiology Chapter of Indian Academy of Pediatrics, Saxena A, Kumar RK, *et al*. Consensus guidelines on pediatric acute rheumatic fever and rheumatic heart disease. *Indian Pediatr* 2008;45:565–73.
35 WHO. *Rheumatic fever and rheumatic heart disease: report of WHO expert consultation*. World Health Organisation Technical report series, 2004: 923.