Asian Biomedicine Vol. 7 No. 2 April 2013; 287-291 DOI: 10.5372/1905-7415.0702.178

Brief communication (Original)

Congenital heart disease in elementary school children in rural Thailand: the role of the trained noncardiologist

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Background: Congenital heart diseases (CHD) comprise about one-third of all major birth defects**.** Children with delayed diagnosis and improper treatment are at a high risk of morbidity and mortality.
Objective: To determine the prevalence of unrecognized congenital heart disease among elementary school students and study the types and frequency of congenital heart disease in Phitsanulok, Pichit, and Kampangpetch provinces of Thailand using trained nurses and other health care personnel.
Methods: Between September 2008 and September 2010, 138,529 students from 1,243 elementary schools were screened for abnormal heart conditions by trained nurses or health care workers. The students who were suspected to have CHD were referred to a pediatric cardiologist for complete evaluation and identification of the lesions.
Results: Five hundred forty eight students were suspected to have heart diseases and 102 students were diagnosed as CHD. The average prevalence of unrecognized CHD in Phitsanulok, Pichit, and Kampangpetch was 0.74 per 1,000. Simple acyanotic lesions (ventricular septal defect, atrial septal defect, and pulmonary stenosis) were common in this study (32.35%, 16.67%, and 11.76%, respectively).
Conclusion: Qualified nurses or health care workers can be useful for identifying patients with CHD. The role of these personnel in the national heart screening program should be further clarified.

Keywords: Congenital heart disease screening in children, prevalence, Thailand

Congenital heart diseases (CHD) comprise about one-third of all major birth defects [1], with a prevalence ranging from 3.7 to 17.5 per 1000 live births [2-5]. In Thailand, the prevalence of CHD in Ayutthaya and Sukhothai provinces was 3 and 1.13 per 1,000 live births, respectively [8]. In the United States, the rate is reported to be 8 per 1000 live births or about 40,000 cases per year [8]. While many newborns with CHD are symptomatic and identified soon after birth, many others remain undiagnosed. Generally, only two in every 1,000 newborns are treated in some form. The children with delayed diagnosis and improper treatment are at high risk of morbidity and mortality [8]. In Thailand, because of inadequate rural medical services, many children with CHD and no or mild symptoms, such as mild pulmonary stenosis or a small atrial septal defect may go undiagnosed and may be subject to complications.

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The purpose of this study was to determine the prevalence of unrecognized CHD among elementary school children (aged 6 to 13 years old) and to study the types of CHD in Phitsanulok, Pichit, and Kampangpetch provinces. The results from this study can be used for planning health care programs to improve current services, leading to a reduction in morbidity and mortality from CHD and improvement of patients' quality of life.

Material and methods

This prospective study covered three provinces of northern Thailand between September 2008 and September 2010. Forty eight thousand three hundred ten students from 466 elementary schools in Phitsanulok (9 districts), 39,474 from 391 elementary schools in Pichit (12 districts), and 50,745 students from 386 elementary schools in Kampangpetch (11 districts) were included. The students who had a known history of cardiovascular malformation or cardiac surgery prior to the beginning of the study, rheumatic heart disease, heart arrhythmia without structural cardiac abnormalities, and those who were

absent from school on the day of scrutiny were excluded from this study. We obtained ethical clearance for this study from Naresuan University Human Ethics Committee. The informed consent forms were signed by the children's parents.

The procedures performed are described in **Figure 1**. The primary screening comprised taking a history, and general physical and cardiovascular examination. This screening included a history of palpitation, chest discomfort, presence of irregular heart rate, abnormal heart sound, heart murmurs, or cyanosis. The primary screening was performed by nurses and health care workers. For accurate primary screening, all of the qualified health care professionals were trained by a pediatric cardiologist and passed a test for their ability to diagnose heart defects. Of the 220 qualified health care professionals trained, 181 (82.3%) passed their first test. After further instruction, all of the selected health care workers passed the test. Following a primary screening step, students with suspected CHD were referred to a pediatric cardiologist for complete cardiovascular examination and management plan. This consisted of 12 lead electrocardiography, chest X-ray imaging and echocardiography.

Data were collected and analyzed to determine the prevalence, and the agreement between primary screening and the diagnosis by pediatric cardiologists. The prevalence of unrecognized CHD per 1,000 elementary school children was calculated from the number of elementary school students with unrecognized CHD multiplied by 1,000 and divided by the total number of elementary school students who participated in this study.

Results

From the three provinces, Phitsanulok, Pichit, and Kampangpetch, 138,529 students underwent the primary screening administered by qualified nurses and other health care workers. Following the primary screening, 189 students from Phitsanulok, 102 students from Pichit, and 257 students from Kampangpetch were suspected to have abnormal heart conditions (**Table 1**). Heart diseases were confirmed in 60 students from Phitsanulok, 33 students from Pichit, and 24 students from Kampangpetch by a pediatric cardiologist. Of the these 117 students, 15 were considered to be non-CHD. Four students from Phitsanulok and two students from Pichit had rheumatic heart disease (mitral regurgitation). In two students

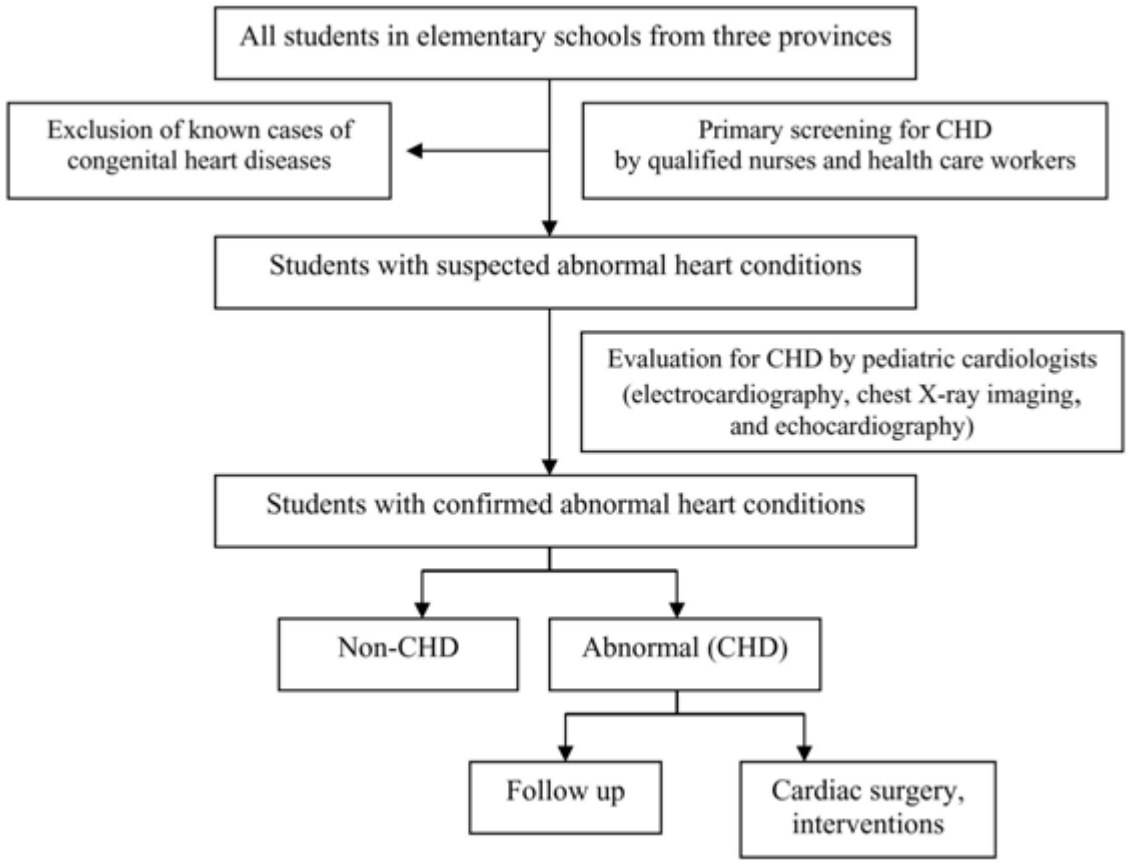

Figure 1. Research flow chart

from Phitsanulok, one had episodes of ventricular tachycardia, one complete heart block. In two students from Pichit, one had ventricular tachycardia, and one had bigeminy. One student from Phitsanulok, two students from Pichit, and two students from Kampangpetch had dilated cardiomyopathy. The 15 non-CHD students were excluded from the data analyses. This resulted in 53 students from Phitsanulok, 27 students from Pichit, and 22 students from Kampangpetch to have confirmed cases of unrecognized CHD. As shown in **Table 1**, the prevalence of undiagnosed CHD among elementary school students in Phitsanulok, Pichit, and Kampangpetch provinces was 1.10, 0.68, and 0.43 per 1,000 students, respectively.

Following the complete cardiac investigation process, the diagnosis and frequency for each different abnormal heart conditions were identified, and summarized in **Table 2**. The common unrecognized CHD in this study were ventricular septal defect (VSD, 32.35%), atrial septal defect (ASD, 16.67%), pulmonary stenosis (PS, 11.76%), tricuspid regurgitation (TR, 10.78%), and aortic stenosis (AS, 4.91%). These simple lesions accounted for 76.47% for the unrecognized CHD.

Table 1. The prevalence of congenital heart disease of elementary students in Phitsanulok, Pichit, and Kampangpetch following primary and secondary screenings

Province	Number of schools	Number of students	Students with positive screening	Students with confirmed CHD	Prevalence rate (per 1,000)
Phitsanulok	466	48,310	189	53	1.10
Pichit	391	39,474	102	27	0.68
Kampangpetch	386	50,745	257	22	0.43
Total	1,243	138,529	548	102	0.74

Table 2. Congenital heart disease detected among elementary school students in Phitsanulok, Pichit, and Kampangpetch

Lesion	Rate	
	Total cases (n)	Percentage (%)
Ventricular septal defect (VSD)	33	32.35
Atrial septal defect (ASD)	17	16.67
Pulmonary stenosis (PS)	12	11.76
Tricuspid regurgitation (TR)	11	10.78
Aortic stenosis (AS)	5	4.91
Pulmonary regurgitation (PR)	5	4.91
Patent ductus arteriosus (PDA)	4	3.92
Tetralogy of Fallot (TOF)	2	1.96
Double outlet of right ventricle (DORV)	2	1.96
TOF + dextrocardia	1	0.98
Aortic regurgitation (AR)	1	0.98
Mitral regurgitation (MR)	1	0.98
TR + PR	1	0.98
Tricuspid atresia + pulmonary atresia + collateral vessels	1	0.98
Pulmonary atresia + VSD + PDA	1	0.98
Hypertrophic obstructive cardiomyopathy	1	0.98
Left pulmonary artery stenosis	1	0.98
Right ventricular non compaction	1	0.98
Ebstein ‘s anomaly	1	0.98
Complex congenital heart disease	1	0.98
Total	**102**	**100**

All of the diagnosed CHD students received further management according to the cardiologist's recommendations. All of the students who underwent heart surgery or other intervention had no serious complications. Almost all CHD students who had indication for correction such as VSD, ASD, PDA, and TOF underwent surgery at Naresuan University Hospital except TOF with dextrocardia patient who was referred.

Discussion

Phitsanulok, Pichit, and Kampangpetch provinces are in the northern area of Thailand. Different environmental factors and socioeconomic problems exist between city and rural areas in these provinces. Furthermore, the general public health care also differs significantly. In the city, the patients can be easily referred to a physician. Rural Thailand has lower socioeconomic status and limited medical facilities. A good primary health care screening may be the most effective way for early identification and good management of many diseases.

One example is congenital heart disease (CHD), a major problem for children in Thailand. The prevalence of CHD ranges from 3.7 to 17.5 per 1000 live births and may vary considerably between different regions [2-5]. Up to 75% of the children with CHD did not exhibit clinical symptoms or signs. Consequently, many children with CHD are unaware of their problems.

A study in Kanpur, North India, reported a prevalence for undiagnosed CHD of 26.4 per 1,000. They studied 10,641 children aged 0 to 15 years over a five and a half year period [5]. This was different from a study in Sahafa, Sudan (prevalence of 2.0 per 1,000 children aged 5 to 15 years) [6] and two previous Thai studies (0.41 to 3 per 1,000) [8, 10]. These differences might be attributed to genetic and environmental factors.

Our study showed an average prevalence of unrecognized CHD among elementary school children of 0.74 per 1,000. This is relatively similar to the prevalence reported in many previous studies [6, 8, 10]. Simple acyanotic lesions (ventricular septal defect, atrial septal defect, and pulmonary stenosis) made up 60.78% of these cases.

Six students had rheumatic heart disease. All cases were mitral valve regurgitation. Five cases were in girls. The mean age of these students was 10.83 years, ranging from 8 to 13 years. Four students lived in rural areas. Of these six cases of rheumatic heart disease, two students were asymptomatic, two reported palpitation,_and two had exertional dyspnea. On clinical examination by a pediatric cardiologist, there were murmurs in five cases. All of these cases had evidence suggestive of RHD by echocardiography. Bhaya et al. reported a high prevalence of rheumatic heart disease in schoolchildren of 51 per 1,000 [15]. This differed from other studies (0.68 to 5.4 per 1,000) [13, 14, 16-19]. There was a higher prevalence of RHD in rural students [17, 19] this may be caused by lower socioeconomic status or delayed treatment of sore throats.

This study has limitations. We depended on the accuracy of primary screening by health care workers for identification of children with potential heart diseases. To reduce screening errors, an initial relaxation period was used to pacify the students' anxiety, which might have affected the primary screening results. A longer period of officers training and practicing can improve the competency of the screeners.

There are several potential benefits from our study. The data will improve general health care workers' awareness of unrecognized CHD in the Thai population. Additionally, this study can guide them to set up appropriate programs and guidelines for screening by health care workers. The sooner the heart problems were detected and managed, the greater the chance for the children with unrecognized CHD to maintain good health.

Moreover, this study assisted provincial health care centers to estimate the number of children with CHD in their areas and can be useful for comparison with numbers of cases in other regions. Better understanding of the distribution of CHD will allow budgeting for specialized care. The screening will identify areas with unusually high prevalence of CHD and allow studies of genetic and other etiological factors that might be amendable.

Conclusion

Qualified nurses and other health care workers can identify unrecognized CHD in patients. A screening model by training paramedics can be developed as a national heart screening programs in all provinces of Thailand.

Acknowledgements

The authors would like to thank Prof. Boonchob Pongpanich, The Cardiac Children Foundation of Thailand, under the royal patronage of H.R.H. Princess Galyani Vadhana, Professor Apichai Kongpattanayothin, Division of Pediatric Cardiology, Department of Pediatrics, Faculty of Medicine, Chulalongkorn University, Prof. Supasit Pannarunothai and Assistant Professor Suwannee Uthaisangsook, Faculty of Medicine, Naresuan University. We also thank Phitsanulok, Pichit, and Kampangpetch Provincial Public Health Offices, and Ministry of Public Health of Thailand for their support. The authors have no conflict of interest to declare.

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