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Research Article

Prevalence of Rheumatic Heart Disease among School Students in a Rural Area of Minia District and the Role of Family Living Conditions as a Risk Factor

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Abstract

Background: In low-income nations, Rheumatic valvular heart disease remains a major cause of morbidity and premature deaths. Accurate prevalence data in Egypt are still lacking yet highly desirable to facilitate healthcare planning. **Aims of study:** To detect the prevalence of rheumatic heart disease among school students aged 12-18 years old in a rural village of Minia district, and investigate the effect of family living conditions as a risk factor. **Methods:** This study is cross-sectional study carried out among school students of Damshir preparatory and secondary school which was selected randomly among 192 villages of Minia district to represent the rural areas. Data was collected during the period from October to December 2023 through a designed well-structured sheet included socio-demographic and clinical data of children. **Results**: Findings revealed that more than half of the studied students (59.6%) were females and their mean age was 14.8 ±1.6 years. Among 403 students aged from 12-18 years attending Damshir preparatory and secondary school 10 students were diagnosed with definite rheumatic heart disease and the prevalence was estimated to be 2.5%. About 90% of students with definite rheumatic heart disease were females compared to 58.8% of students with normal ECHO findings (p=0.04). Multiple logistic regression analysis demonstrates that there was a significant association between age and history of tonsillitis with rheumatic heart disease. **Conclusions:** Rheumatic heart disease is an important health problem among school students of rural areas of Minia District. Several factors like age, sex and tonsillitis history can affect rheumatic heart disease.

Keywords: Rheumatic heart disease; Epidemiology; Students

Introduction

It is a sad reality that although eminently preventable, and despite possessing such knowledge for more than 70 years, rheumatic heart disease remains the most common cause of cardiovascular morbidity and early mortality in young people worldwide. A disease of the poor, rheumatic heart disease is one of the most neglected diseases. Several challenges are unique to the acute rheumatic fever/ rheumatic heart disease continuum and contribute to its persistence, including its sequestration among the poorest, its protracted natural history, the erratic availability of penicillin, and the lack of a concerted effort in endemic regions [1].

There are considerable gaps in knowledge of the etiology and risk factors of acute rheumatic fever. This limits the effectiveness of disease control and prevention interventions[2]. Attempts to identify host factors have produced inconsistent results. [3,4] A few case control studies of acute rheumatic fever have been conducted [5,6]

but none of a high quality [7, 8]. One study identified several factors as significantly associated with acute rheumatic fever, the strongest being parental unemployment [5]. Poor living conditions, including home dampness and home crowding were significant risk factors[5]. Frequent sore throat and low education level of mother were also risk factors[5]. Another study identified associations with acute rheumatic fever and low income, substandard housing and poor nutritional status [6].

In most studies, rheumatic heart disease prevalence is high in rural areas. For instance, indigenous Australians living in distant communities are 3.3 times more likely to develop acute rheumatic fever than indigenous people living in urban centers in the same region [9]. Similar findings have been recorded from other regions [10].

Rheumatic heart disease is the most serious complication of rheumatic fever whereby patients develop heart valve regurgitation or stenosis, atrial dilation, arrhythmias and right ventricular dysfunction [11]. After a patient has had rheumatic fever, there is often a prolonged period of subclinical disease characterized by changes in valvular morphology and function [12]. It has been shown that 40 to 65% of patients who have had rheumatic fever get clinically recognizable rheumatic heart disease [13, 14].

Primary prevention of acute rheumatic fever is accomplished by proper identification and adequate antibiotic treatment of group A beta-hemolytic streptococcal tonsillopharyngitis. Diagnosis of group A beta-hemolytic streptococcal pharyngitis is best accomplished by combining clinical judgment with diagnostic test results, the criterion standard of which is the throat culture. Penicillin (either oral penicillin V or injectable benzathine penicillin) is the treatment of choice, because it is cost-effective, has a narrow spectrum of activity, and has long-standing proven efficacy, and group A beta-hemolytic streptococcal resistant to penicillin have not been documented. [15]

Methods

Study design and population

This cross-sectional study was conducted among students of Damshir preparatory and secondary school, Damshir, Minia, Egypt, which was selected randomly among 192 villages in Minia to represent a rural area in Minia district. The study was carried out during the period from October to December 2023 and included students aged 12-18 years old. The total number of the school students was 440 students of which 403 students agreed to participate in the study with response rate 91.6%.

Data collection

All students and their parents were interviewed and data was collected by a designed well-structured sheet. The aim of the study was explained, consents from the parents were obtained and the questions were filled in by the researcher. The work up included: socio-demographic data as age, sex, father and mother occupation and education, family history, medical history, sanitation and housing condition as well as clinical presentation, laboratory investigation including Antistreptolysin O titre (ASO) and Erythrocyte sedimentation rate (ESR), echo findings and type of treatment. All students were referred to the Health Insurance Hospital in Minia for investigations.

Diagnosis of rheumatic heart disease was based on medical history including evidence of past acute rheumatic fever by using Jones criteria for diagnosis or streptococcal infection with Echo findings of all students.

Results

As shown in table 1, the age of the studied students ranges from 12-18 years with a mean age of 14.78±1.63 years. More than half of them are females (59.6%) and most of them have big family size (78.7%). The study found that 30.8% of students have three siblings and 48.9% of them have four or more siblings. Most of the studied students are in preparatory level (63.8%), and about 36.2% are in secondary level. Most of the students' mothers (92.3%) are housewives and 45.7% are illiterates, while about 46.4% of their fathers are educated

till secondary level and 30.0% of them are illiterate or only read and write.

Table (2) shows that 16.4% of the studied students had positive family history of rheumatic heart disease, and about 33.7% of them had positive paternal consanguinity, about half of the studied students (50.1%) had positive history of anemia, and 40.9% of the students had positive history of dyspnea and easy fatigability on slight effort. Moreover, 25.8 %of the students had positive history of repeated attack of tonsillitis, 50.4% had positive history of arthralgia, and 9.9% of them had positive history of skin infection.

Table (3) Illustrates sanitation conditions of the houses of the studied students according to presence of pure water supply, electricity and special water closet inside the house. It was found that 25.8% of the students have all of the three sanitation conditions, 63.0%of them have two of the three and 11.2% of them have only one of the three. Moreover, about 12.9% of the studied students sometimes notice moulds in the ceilings in their bedrooms or living areas of their homes and about 7.7% of them always notice it. Moreover, in the last 12 months, 10.4% of students sometimes notice damp or musty smell in the bedrooms or living areas of their home, and about 3.7% of them always notice its presence. Also, 17.1%of them their houses always have been cold causing them to shiver, and about 25.8% of them sometimes suffer from shivering due to their cold houses. More than half of the studied students (67.7%) meet their friends or other students after school, and 33.7%of them play regular sports. Moreover, 41.9% of the studied students live with a smoker in the house.

Table (4) shows that 15.6% of the studied students have carditis ,8.9% of them have polyarthritis. None of the studied students were suffering from chorea, erythema marginatum, or subcutaneous nodules, about 46.2% of the studied students have fever, and 48.9% of them were suffering from arthralgia. About half of the students 50.1% were found to have elevated acute phase reactant (ESR), and 6.9% of them have prolonged PR interval.

Table (5) illustrates the laboratory results, Echo results and the current medication of the studied students. About 41.4% of the students have positive ASO titer level, and about half of them (50.1%) were found to have high ESR level. Based on the Echo results, 10 students had definite rheumatic heart disease findings. Therefore, the prevalence of rheumatic heart disease among the studied students of Damshir preparatory and secondary school was estimated to be 2.5%.

The mean age of students with definite rheumatic heart disease was 16.7±1.7 years and 90% of them were females compared to 58.8% of students with normal Echo findings (p=0.04). As shown in table (6) the multiple logistic regression revealed that the developing of rheumatic heart disease is significantly associated with higher age and history of tonsillitis.

Table (1): Socio-demographic characteristics of the studied students Damshir School, Minia (2022-2023)

Socio-demographic characteristics		Number n=403	Percentage
Age (years)	**(mean±SD)**	14.78±1.63	
	Range	(12-18)	
Sex	Male	163	40.4%
	Female	240	59.6%
Family size	Big family size	317	78.7%
	Small family size	86	21.3%
Number of sibling	One	19	4.7%
	Two	63	15.6%
	Three	124	30.8%
	Four or more	197	48.9%
Stage of Education	Preparatory	257	63.8%
	Secondary	146	36.2%
Education of the mother	Illiterate /read and write	184	45.7%
	Primary	9	2.2%
	Preparatory	17	4.2%
	Secondary	153	38.0%
	University or higher	40	9.9%
Occupation of the mother	Housewife	372	92.3%
	Government employee	24	6.0%
	Private employee	7	1.7%
Education of the father	Illiterate/read and write	121	30.0%
	Primary	10	2.5%
	Preparatory	27	6.7%
	Secondary	187	46.4%
	University or higher	58	14.4%
Crowding index	Mean±SD	1.97±0.87	
Family income meets family expenses	Yes and save	36	8.9%
	Yes	179	44.4%
	Sometimes	109	27.0%
	No	79	19.6%

Table (2): Family history, consanguinity, and medical history of the studied students, Damshir School, Minia (2022-2023)

Family history and consanguinity		Number n=403	Percentage
Family history of rheumatic fever or rheumatic heart disease	Yes	66	16.4%
	No	337	83.6%
paternal consanguinity (1st degree)	Yes	136	33.7%
	No	267	66.3%
History of anemia	Positive	202	50.1%
	Negative	201	49.9%
History of dyspnea and easy fatigability on slight effort	Positive	165	40.9%
	Negative	238	59.1%
History of upper respiratory tract infections	Positive	133	33.0%
	Negative	270	67.0%
History of repeated attack of tonsillitis	Positive	104	25.8%
	Negative	299	74.2%
History of arthralgia	Positive	203	50.4%
	Negative	200	49.6%
History of skin infection	Positive	40	9.9%
	Negative	363	90.1%
History of scabies	Positive	2	0.5%
	Negative	401	99.5%

Table (3): Sanitation and housing conditions of the studied students, Damshir School, Minia (2022-2023)

Housing conditions		Number n=403	Percentage
Exposure to mould in the house	Yes always	30	7.4%
	Yes sometimes	52	12.9%
	No	321	79.7%
Exposure to damp or musty smell in the house	Yes always	15	3.7%
	Yes sometimes	42	10.4%
	No	346	85.9%
Sharing a sleeping room to stay warm	Yes always	155	38.5%
	Yes sometimes	89	22.1%
	No	159	39.5%
Exposure to extreme cold in the room and shivering	Yes always	69	17.1%
	Yes sometimes	104	25.8%
	No	230	57.1%
Avoid cold shower/bath because there is not enough hot water	Yes always	47	11.7%
	Yes sometimes	75	18.6%
	No	281	69.7%
Meeting friends or other students after school	Yes	273	67.7%
	No	130	32.3%
Playing regular sport	Yes	136	33.7%
	No	267	66.3%
Attending regular meetings	Yes	183	45.4%
	No	220	54.6%
Pure water supply, electricity, water closet in the house	All of the three	104	25.8%
	Two of the three	254	63.0%
	One of the three	45	11.2%
Living with a smoker	Yes	169	42%
	No	234	58%

Table (4): Major and Minor Jones criteria of the studied students Damshir School, Minia (2022-2023)

Major criteria		Number n=403	Percentage
Carditis	Yes	63	15.6%
	No	340	84.4%
Polyarthritis	Yes	36	8.9%
	No	367	91.1%
Chorea	Yes	0	0
	No	403	100.0
Erythema marginatum	Yes	0	0
	No	403	100.0
5.Subcutaneous Nodules	Yes	0	0
	No	403	100.0
Minor criteria			
Fever (with history of sore throat)	Yes	186	46.2%
	No	217	53.8%
Arthralgia	Yes	197	48.9%
	No	206	51.1%
Previous rheumatic fever or rheumatic heart disease	Yes	13	3.2%
	No	390	96.8%
Elevated acute phase reactant (ESR) Arthralgia	Yes	202	50.1%
	No	201	49.9%
Prolonged PR interval	Yes	28	6.9%
	No	375	93.1%

- Carditis is inflammation of all parts of the heart, primarily mitral valves.
- Polyarthritis is tender, painful joints knee, elbow, ankles
- Chorea is involuntary movement of extremities and face affect speech
- Erythema marginatum is red skin lesions starting on trunk and spreading peripherally.
- Subcutaneous nodules is small, non tender swelling often over the joint

-To diagnose a patient with rheumatic fever as a first episode of the disease, a confirmation of two major criteria or one major and two minor criteria is required, along with evidence of antecedent Group A β-hemolytic streptococcal infection. [16]

Table (5): laboratory, echocardiographic results and current medication of the studied students Damshir School, Minia (2022-2023)

Laboratory tests		Number n=403	Percentage
ASO titer	Positive	167	41.4%
	Negative	236	58.6%
ESR	High	202	50.1%
	Low	201	49.9%
Echo results			
ECHO	Normal	342	84.9%
	Definite rheumatic heart disease	10	2.5%
	Mitral valve prolapse	4	1.0%
	Mitral stenosis	5	1.2%
	Mitral regurge	16	4.05%
	Aortic regurge	19	4.0%
	Congenital	7	1.7%
Medication			
Long acting Penicillin	Yes	139	34.5%
	No	264	65.5%
Anti-inflammatory	Yes	86	21.3%
	No	317	78.7%
Anti-seizure	Yes	2	.5%
	No	401	99.5%

NB. None of the studied students took salicylate or corticosteroids

Table (6): Multiple logistic regression analysis of factors associated with rheumatic heart disease, Damshir School, Minia (2022-2023)

	Adjusted OR (95% CI)	P-value
Crowding index	0.48 (0.12 - 1.89)	0.296
Age	3.96 (1.37 – 11.42)	0.011*
Sex (male)	0.18 (0.01 - 3.01)	0.233
Family History	1.29 (0.18– 9.11)	0.796
Anemia	2.24 (0.34 – 14.97)	0.405
Tonsilitis History	10.9 (1.83 – 64.74)	0.009*
Upper respiratory tract infection	4.79 (0.79 - 29.16)	0.089
Education	27.66 (0.48-158.8)	0.108
Family Size	0.49 (0.06 - 3.92)	0.504
Mould History		
Yes always	1.31 (0.03– 58.18)	0.889
Yes some times	1.79 (0.03– 99.10)	0.775
House Damp		
Yes always	18.1 (0.34 – 973.3)	0.154
Yes some times	3.23 (0.10 – 104.3)	0.509

Discussion

This study found that the prevalence of rheumatic heart disease among preparatory and secondary students of Damshir school is 2.5%. These findings are in line with a study conducted by Fareed et al. 2023 about screening for the prevalence of rheumatic heart disease among school children in

Egypt, and found that the prevalence of rheumatic heart disease among school children is 2.3% [17]. In 2013, El-Aroussy et al., also found that the prevalence of rheumatic valvular heart disease among Egyptian school children by an echocardiographic screening was 2.2% [18].

The prevalence of rheumatic heart disease in this study was lower than the findings of some studies. In Nicaragua, Paar et al. 2010 studied prevalence of rheumatic heart disease in children and young adults and found that the prevalence of rheumatic heart disease was 4.8% [19]. Moreover, in Tanzania in 2021 Kazahura et al., who studied the prevalence and risk factors for subclinical rheumatic heart disease among primary school children in Dar es Salaam, Tanzania through a community based cross-sectional study found that the prevalence of rheumatic heart disease is 3.4% [20]

The current study found that the mean age of the students with definite rheumatic heart disease was 16.7±1.7 years. This finding is higher than the finding of a study in Indonesia in 2020 by Lilyasari et al., who studied the clinical profile and management of rheumatic heart disease in children and young adults at a tertiary cardiac center and found that 297 patients were diagnosed with rheumatic heart disease, of whom 108 were children with mean age of 12.02 ± 3.36 years [21]. On the other hand, a study in Brazil in 2020 was conducted by Antunes who studied the global burden of rheumatic heart disease and found that the mean age of rheumatic heart disease patients is 20-25 years [22].

Regarding sex, the current study found that 90.0% of students with definite rheumatic heart disease were females (p=0.04). This is similar to a study in 2022 by DesJardin et al., addressed sex differences and similarities in valvular heart disease and found that the majority of aortic stenosis patients were women [24]. Additionally, a study in 2018 in Brazil by Nascimento et al. who studied comparison between different strategies of rheumatic heart disease echocardiographic screening found that the prevalence of rheumatic heart disease was higher in girls (p=0.02) [25]. Several studies have shown the differences between males and females in terms of disease presentation, response to treatment and prognosis. However, it remains unclear whether this gender difference is a true biological sex difference or due to sex bias in medical care, in which females are less likely to get correct screening and prevention strategies [23].

The current study found that rheumatic heart disease is significantly associated with history of tonsillitis and there is a significant association between tonsillitis and carditis. This is in line with a study in 2009 by Talmon et al, addressed acute myopericarditis complicating acute tonsillitis and found that there was 1 clear-cut case of acute myopericarditis and 5 more patients with pathological findings suggesting cardiac complication [26]. Additionally, a study in 2008 conducted by Talmon et al. addressed acute myopericarditis complicating acute tonsillitis found that the average latency from the onset of throat pain to the onset of chest pain was 4.6 days. Moreover, all patients complained of chest pain and the levels of cardiac enzymes and troponin were elevated in all cases [27].

On the contrary, the finding of a systematic review study in 2022 conducted by Schmutzler and Mirna found that myocarditis after streptococcal pharyngitis and/or tonsillitis is a rather infrequently described disease [28].

The association between tonsillitis and rheumatic carditis can be explained by activation of the innate immune system that begins with a pharyngeal infection and leads to the presentation of S. pyogenes antigens to T and B cells. CD4+ T cells are activated and production of specific IgG and IgM antibody by B cells ensues. Tissue injury is mediated through an immune-mediated mechanism that is initiated via molecular mimicry [29]. Moreover, structural similarity between the infectious agent and human proteins leads to the cross-activation of antibodies and/or T cells directed against human proteins [30]. In acute rheumatic fever, this cross-reactive

immune response results in the clinical features of rheumatic fever, including carditis, due to antibody binding and infiltration of T cells [31].

Conclusion:

Rheumatic valvular heart disease remains prevalent in Egypt. The prevalence of rheumatic heart disease was estimated to be 2.5% in Damshir preparatory and secondary school with higher levels in females than males. Great attention should be paid towards regular follow up of students with recurrent tonsillitis and positive family history of the disease.

Recommendation:

1- Health education to parents and students in rural areas to be aware of the disease and its complications

2- Regular follow up to rural students through primary health unit for prevention of the disease and detection of subclinical cases.

3- More effort to increase sanitary level of rural houses is required.

4- Future studies are needed in this aspect to assess the different risk factors associated with rheumatic heart disease.

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