Original Article

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.1469413
J Health Sci Med. 2024;7(3):321-326

Acute rheumatic fever: a single center experience

Tunç Tunçer
Department of Pediatrics, Faculty of Medicine, Zonguldak Bülent Ecevit University, Zonguldak, Turkiye

Cite this article as: Tunçer T. Acute rheumatic fever: a single center experience. *J Health Sci Med.* 2024;7(3):321-326.

Received: 17.04.2024 ◆ **Accepted**: 12.05.2024 ◆ **Published**: 27.05.2024

ABSTRACT

Aims: Acute rheumatic fever continues to be a serious public health issue globally and in our country. The aim was to evaluate the socioeconomic, clinical characteristics, and echocardiographic findings of patients diagnosed with acute rheumatic fever in the Sancaktepe district of Istanbul province, and to compare them with Turkiye and global data.

Methods: The study was conducted retrospectively by reviewing the hospital records of 22 patients who presented to the pediatric cardiology outpatient clinic of Sancaktepe Training and Research Hospital and were diagnosed with acute rheumatic fever between March 2018 and October 2021. Demographic and socio-economic data, complaints, physical examination findings, clinical and laboratory features, initial echocardiographic findings at presentation, and follow-up data of the patients were identified.

Results: Out of the 22 patients diagnosed with acute rheumatic fever, 13 (59.1%) were male, with a mean age of 131.9 months ±32.9. The patients were followed up for an average of 23.2±11.5 months. Most patients (36.3%) presented during the winter months. The average number of individuals living in the patients' households was found to be 5.8±1. It was observed that 95% of the mothers and 45.5% of the fathers had completed primary education, none of the mothers were employed, and all employed fathers received minimum wage. A family history of acute rheumatic fever was present in 18.8% of the patients. When echocardiographic findings were evaluated, valve involvement was detected in 90.9% of the patients. While single valve involvement was observed in the majority (72.7%) of patients, mitral valve involvement was most common (81.8%). During the follow-up period, complete resolution was observed in 45.5% of patients with mild mitral regurgitation and 66.6% of patients with mild aortic valve regurgitation.

Conclusion: While the majority of the data in the study are consistent with the literature, attention has been drawn to the challenges associated with the low socioeconomic status of our patient population. With the increase in socioeconomic status in our country, as in developed countries around the world, the incidence of disease may decrease.

Keywords: Acute rheumatic fever, social class, echocardiography

INTRODUCTION

Acute rheumatic fever (ARF) emerges as an immunologically mediated and non-suppurative complication of group A streptococcal infection. It affects the heart, joints, central nervous system, skin, and subcutaneous tissue. While the incidence of ARF has decreased in Europe and North America due to preventive measures, it continues to be a significant public health issue in developing countries.[1,2] The diagnostic criteria for ARF were established by Jones in 1944 and were last updated by the American Heart Association (AHA) in 2015.[3] According to the Jones criteria revised by the AHA in 2015; populations are divided into two risk groups, low-risk and moderate-to-high-risk. In the presence of reliable epidemiological data, an ARF incidence of ≤2/100,000 school-aged children (usually aged 5-14 years) per year or a prevalence of rheumatic heart disease of ≤1 per 1000 population of all ages can be considered low-risk. While the global incidence of ARF varies by geographical region and population, the average global incidence of ARF is 19/100,000.[2] In developed countries, this incidence ranges from 0.5 to 3/100,000, while in developing countries; it varies between 20 and 200/100,000.[1,4,5] Various studies on the incidence of ARF have been conducted in different geographical regions and cities in Turkiye at different times, but the multicenter national study conducted in 2016 is the most recent and comprehensive.[6-11] In this study, the incidence of ARF for Turkiye was determined to be 8.84/100,000.[11] When evaluated in terms of geographical regions, the highest incidence was found in the Eastern Anatolia region (14.4/100,000), while the lowest incidence was observed in the Black Sea region (3.3/100,000).

The clinical profile of ARF generally shows similarities between low-risk and moderate-to-high-risk groups, with the most common findings worldwide being arthritis (35%-66%) and carditis (50%-70%). These are followed in frequency by chorea (10%-30%), subcutaneous nodules (0%-10%), and erythema marginatum (<6%).[3] In the largest series study conducted in our country, based on data collected from all geographical regions, clinical carditis (53.5%) was the most frequently detected finding among 1103 patients diagnosed with ARF between January 1 and December 31, 2016.[11] This

Corresponding Author: Tunç Tunçer, volgatin@hotmail.com

was followed by polyarthritis (52.8%), subclinical carditis (29.1%), polyarthralgia (18.6%), aseptic monoarthritis (10.3%), Sydenham chorea (7.9%), and erythema marginatum (0.4%), while subcutaneous nodules were not observed.

According to the data from the Turkish Statistical Institute's 2021 census, the total population of Sancaktepe district in Istanbul province is 474,668, which is greater than the population of 47 provinces in Turkiye.[12] In 2022, The Ministry of Industry and Technology of the Republic of Turkiye conducted a research to determine the socio-economic development ranking of districts in Turkiye. Sancaktepe district is ranked 95th and is 34th among the 39 districts of Istanbul.[13] This study was conducted to reveal the demographic characteristics, socioeconomic status, clinical characteristics, and follow-up results of patients diagnosed with ARF at the Pediatric Cardiology Clinic of Sancaktepe Training and Research Hospital in Istanbul province's Sancaktepe district. The aim of the study is also to compare these findings with data from around the world and Turkiye.

METHODS

The study was carried out with the permission of Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital Scientific Researches Ethics Committee (Date: 24.03.2021, Decision No: 2021/124). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. As it is a retrospective study, consent was not obtained from the parents of the patients. Missing data regarding socioeconomic status in the files were completed by reaching out to individuals via telephone.

The study was conducted by retrospectively reviewing patients who presented to the Pediatric Cardiology Clinic of Sancaktepe Training and Research Hospital in Sancaktepe district of Istanbul province between March 2018 and October 2021. Patients were identified from the hospital's medical record system. Patients who were diagnosed with ARF for the first time in the clinic between the specified dates were included. The diagnosis of ARF was made according to the updated Jones criteria in 2015.[3] Patients with either two major criteria or one major and two minor criteria in the presence of a history of preceding infection were considered to have active ARF. In distinguishing between physiological and pathological valve insufficiency, the Doppler revision criteria for rheumatic valvulitis were used.[3] According to these criteria, the following conditions must be met for both the mitral and aortic valves: insufficiency observed in at least two imaging planes, peak velocity >3 m/s, pansystolic jet for the mitral valve, pandiastolic jet for the aortic valve, insufficiency jet length ≥2 cm for the mitral valve (in at least one imaging plane), and insufficiency jet length ≥1 cm for the aortic valve (in at least one imaging plane). Demographic information, presenting complaints, and examination findings of the patients were recorded. Laboratory tests including erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and serum antistreptolysin-O (ASO) levels were determined. Electrocardiographic and transthoracic echocardiographic findings were documented. Treatments and responses to treatment were recorded.

Aspirin (100 mg/kg/day) was administered to patients with arthritis and mild carditis for 2-4 weeks and then gradually tapered off. Prednisolone (2 mg/kg/day) was given to patients with moderate to severe carditis for 4-6 weeks, and aspirin was added to the treatment during the tapering period. As primary prophylactic treatment, a single dose of intramuscular benzathine penicillin was administered, while in secondary prophylactic treatment, benzathine penicillin G (>27 kg: 1,200,000 units, <27 kg: 600,000 units) was given every 21 days.

Socioeconomic status (SES) is a widely used concept in health research. Although researchers may have an intuitive understanding of what SES entails, numerous measurement methods demonstrate the complexity of the construct. There is no single best SES indicator that can be universally applied to all research purposes, settings, and time points. Each indicator measures different, often interrelated aspects of socioeconomic stratification and may be more or less relevant to different health outcomes and stages of life.[14] Therefore, in this study, questions were selected with a focus on life stages (such as the pediatric age group), and SES question types were chosen accordingly.[15]

Transthoracic echocardiography was performed using the Philips Affiniti 50 c echocardiography system (Philips Healthcare, Andover, MA, USA). The Philips S4-2 Cardiac Sector Probe and Philips S8-3 Cardiac Sector Probe were utilized. All cases were evaluated by the same pediatric cardiologist. Standard echo modes including M-mode, 2D, color, pulse and continuous Doppler, and tissue Doppler were employed.

Statistical Analysis

Statistical analysis was conducted using JASP (Jeffreys's Amazing Statistics Program, version 0.14.1.0, Department of Psychological Methods, University of Amsterdam, The Netherlands). Descriptive statistics were employed to summarize the demographic and clinical characteristics of the patients. Continuous variables were presented as mean±standard deviation (SD), while categorical data were expressed as numbers and percentages.

RESULTS

Between March 2018 and October 2021, a total of 22 patients were identified with a diagnosis of ARF. Among them, 13 (59.1%) were male and nine (40.9%) were female (male/female ratio: 1.44). The mean age was determined to be 131.9 months ±32.9 (minimum: 66 months and maximum: 181 months) (Table 1).

The mean body weight and height of the patients were determined to be 39.2±12.4 kg and 144.18±13.7 cm, respectively, with percentile means of 49.4±19.7 and 47.1±21.3. For patients diagnosed only with clinical carditis and/or polyarthritis, the mean body weight and height percentile means were found to be 37.9±17.4 and 32.5±16.8, respectively. However, in all patients diagnosed with subclinical carditis and/or polyarthritis or polyarthralgia or only chorea, the mean body weight and height percentile means were determined to be 64±10.5 and 64.5±36.4, respectively.

Table 1. General characteristics of the study group and study results		
	Number	Percentage
Male	13	59.1
Female	9	40.9
Complaints at admission		
Joint pain	14	63.6
Fever	7	13.6
Audible murmur during examination	6	27.2
Chest pain	4	18.8
Elevated ASO levels	2	9
Physical examination findings		
Pansystolic murmur at mitral area	12	54.5
Arthritis	11	50
Chorea	1	4.5
Signs of heart failure	1	4.5
Major and minor findings		
Clinical carditis	12	54.5
Subclinical carditis	6	27.2
Polyarthralgia	4	18.1
Carditis+polyarthritis	9	40.9
Subclinical carditis+polyarthralgia	4	18.1
Fever	7	31.8
PR prolongation in ECG	3	13.6
Increased ESR	18	81.8
Increased CRP	17	77.2
Evidence of preceding group A streptococcal infection		
Elevated ASO levels	20	90.9
Positive throat culture	3	13.3

ASO: Serum antistreptolysin-O, ESR: Erythrocyte sedimentation rate, CRP: C-reactive protein

The average number of individuals in the households where the patients lived was determined to be 5.8±1. When questioned about the mother's education level, it was found that one mother was illiterate, while the rest (95%) had completed primary school. Regarding the father's education level, it was found that ten (45.5%) had completed primary school, seven (31.8%) had completed middle school, and five (22.7%) had completed high school. When asked about employment status, all mothers stated that they were not working, while all fathers except one stated that they had a job available. It was noted that all working fathers earned minimum wage. When asked about homeownership, 12 families (54%) stated that they owned their homes. Regarding the type of housing, six families (27.2%) lived in slums, six families (27.2%) lived in detached houses, and ten families (45.4%) lived in apartment buildings. None of the patients had their own rooms. All parents of the patients reported that they had migrated from Eastern and Southeastern provinces to Sancaktepe within the last 20 years.

The patients were followed for an average of 23.2±11.5 months (minimum 3 and maximum 42 months). When the timing of patient admissions was examined, it was found that they most commonly occurred during the winter months (Table 1). A history of acute rheumatic fever was present in four patients' families (18.8%).

The patients' presenting complaints, physical examination findings, and major and minor criteria identified in the patients are shown in Table 1. None of the patients had erythema marginatum, subcutaneous nodules, or monoarthritis detected. One patient (4.5%) was classified as having severe carditis, two patients (9%) had moderate carditis, and 17 patients (77.2%) had mild carditis. One patient was recorded as having arthritis, and one patient was noted to have chorea.

When laboratory findings were examined, the mean C-reactive protein and erythrocyte sedimentation rate were found to be 13.2±7.7 mg/dL and 47.4±18.1 mm/hour, respectively. Throat cultures were taken from all patients, and ASO titers were tested (Table 1).

When transthoracic echocardiography findings were evaluated, valve involvement was observed in 20 patients (90.9%). While most patients had involvement of a single valve, mitral valve involvement was most common (Table 2). The mean length of mild mitral regurgitation jet was measured as 2.2±0.11 cm, and the mean length of moderate mitral regurgitation jet was measured as 3.3±0.17 cm. Severe mitral regurgitation was detected in only one patient (4.5%), who also had moderate aortic valve regurgitation.

Table 2. Transthoracic echocardiography findings		
	Number	Percentage
Valve involvement	20	90.9
Single valve involvement (mitral or aortic valve)	16	72.7
Dual valve involvement (mitral and aortic valve)	4	18.1
Mitral valve involvement only	14	63
Aortic valve involvement only	2	9
Mild mitral regurgitation	11	50
Moderate mitral regurgitation	6	27.2
Severe mitral regurgitation	1	4.5
Mild aortic regurgitation	2	9

Mild aortic valve regurgitation was detected in two patients (9%) who had only aortic valve involvement (Table 2). One patient had mild aortic valve regurgitation along with moderate mitral valve regurgitation, while two patients had severe aortic valve regurgitation along with moderate and severe mitral valve regurgitation, respectively. The mean length of the aortic regurgitation jet was recorded as 1.78±0.58 cm.

During the follow-up period, among the 11 patients with mild mitral regurgitation, complete resolution was observed in five patients (45.5%), while no change was observed in five patients (45.4%). In one patient, there was no improvement and aortic valve regurgitation was added to the condition. Among the six patients with moderate mitral regurgitation, two patients (33.3%) had their moderate regurgitation converted to mild regurgitation, while three patients (50%) persisted with moderate regurgitation, and one patient had aortic valve regurgitation added to the existing condition. Among the three patients with mild aortic valve regurgitation, improvement was observed in two patients (66.6%), while one patient persisted with the condition. Among the two patients with moderate aortic valve regurgitation, one patient's condition improved to mild, while no change was observed in the other.

DISCUSSION

Although acute rheumatic fever is preventable and treatable, it unfortunately remains a significant health issue worldwide. It is particularly prevalent in developing and underdeveloped countries and stands as one of the leading causes of acquired heart disease.[1,3,4]

In the most recent multicenter national study conducted in Turkiye in 2016, the incidence of acute rheumatic fever was determined to be 8.84/100,000.[11] In this study, the incidence in the Marmara region, which includes the Sancaktepe district, was found to be 6.6/100,000. Although this value is lower than the incidence nationwide, it is higher than the incidence figures in developed countries. The distribution of age, gender, and time of presentation of patients diagnosed with acute rheumatic fever in our study is similar to the current data in Turkiye.[11,16,17] However, in some studies conducted in Turkiye with a small number of patients, the gender distribution shifted towards females, and the disease was found to be more prevalent in the spring season.[18-20] When compared with other countries around the world, both our study and the current data in Turkiye show similarities in age distribution. However, in studies conducted in different geographical locations such as Fiji, Australia, New Zealand, and Thailand, unlike Turkiye, the disease was found to be more common in females, with peaks even occurring in August in New Zealand.[21-24]

It is noteworthy that the average weight and height percentiles of the patients in our study were found to be below the 50th percentile. While all patients with subclinical carditis and/or polyarthritis or polyarthralgia or only chorea had weight and height percentiles above the 50th percentile, those with only clinical carditis and/or polyarthritis were found to be below the 50th percentile. This situation may be associated with the population of the Sancaktepe district, especially consisting of citizens who have migrated from the Eastern and Southeastern Anatolia regions. Indeed, 305,016 (64.2%) of the district's population of 474,668 are from these regions and are socioeconomically disadvantaged.[12] Coffey et al.[25] investigated the relationships between factors affecting health such as living in crowded environments, education level, family income level, and social structure, and the prevention of and risks for Group A streptococcal infection, acute rheumatic fever, and rheumatic heart diseases in their systematic review study. They found a positive relationship between living in crowded environments, nutritional level, parents' education and employment status, and acute rheumatic fever. Similarly, Stacey et al.[24] in their study conducted in Australia where they published the long-term outcomes of patients with acute rheumatic fever, showed that more than half of the patients (52.1%) were of low socioeconomic status. The data I collected regarding the socioeconomic levels of the patients in our study also supports this finding.

When comparing the complaints of the patients in the study with the previous studies, it was observed that a large majority of previous studies focused more on physical examination findings rather than patient complaints. In our study, joint pain was the most common complaint, followed by fever. In previous studies, joint pain has been reported as the most common complaint.[16,26,27]

Considering the physical examination findings, in our study, arthritis was the most common, followed by carditis, which is consistent with the literature findings. Similar to my study, in most studies with a small number of patients, except for one, erythema marginatum and subcutaneous nodules were not encountered.[20] In the recent study covering data from all over Turkiye, subcutaneous nodules were not found, and erythema marginatum was determined to be 0.4%.[11]

Carditis, seen in 30-80% of patients, is the most important major manifestation that determines the prognosis of the disease.[3,28] When cardiac findings were examined in detail in our study, clinical carditis was observed in 54.5% and subclinical carditis in 27.2% of patients. My data are consistent with the recent multicenter study data from our country and global data.[3,4,11,28-30] However, in most of the similar single-center studies conducted in our country, patients were not examined with a distinction between clinical carditis and subclinical carditis.[16,18,20] In one of the studies where this distinction was made, the rates for clinical carditis and subclinical carditis were found to be 48% and 36%, respectively, while in another study, they were determined to be 30.7% and 36%.[19,31] The first of these studies was conducted in Erzurum, while the other was conducted in Ankara. The results of the study conducted in Erzurum are similar to my study, as both study populations originate from similar geographical regions and likely represent similar socioeconomic classes. Subclinical carditis can be observed in a wide range of 0% to 53% worldwide.[3] In a study conducted in Bangladesh in 2023, 64.9% of patients with detected carditis were classified as subclinical carditis.[32] This situation can be explained by the widespread use of echocardiography.[3] However, delays in accessing healthcare due to socioeconomic reasons, as possible in our study, may increase the likelihood of patients being diagnosed with clinical carditis to a greater extent.

When joint findings were evaluated, polyarthritis or polyarthralgia was detected in 68.1% of patients in our study, while no patients were found to have monoarthritis or monoarthralgia. The data are consistent with the literature data regarding polyarthritis or polyarthralgia, but the absence of monoarthritis or monoarthralgia may be explained by the small size of the study population.[3,4,11,16-20,28,31,32] There are studies with relatively few patients where monoarthritis or monoarthralgia was not detected (number of patients ranging from 34 to 55).[17-20] Moreover, even in the most recent and comprehensive study including 1103 patients, monoarthralgia was reported as 1.6%.[11]

When the minor criteria of ARF (CRP, ESR, Fever, PR prolongation in ECG, etc.) and evidence of preceding Group A streptococcal infection (ASO and throat culture) values were examined in our study, they showed similarities with single-center studies conducted in our country, as well as with recent multicenter studies and studies conducted in different countries around the world.[11,16,18-20,30,31,33-35] Unlike other studies, monoarthralgia was not observed among the minor criteria in our study. This could be attributed to the small sample size in our study, as mentioned earlier. Although throat cultures were obtained from all patients and ASO titers

were determined in our study, only three patients (13.3%) had positive findings for group A beta-hemolytic streptococci in throat cultures, while elevated ASO levels were detected in twenty patients (90.9%), which may be associated with the use of antibiotics before referral by the patients.

Considering the data obtained from transthoracic echocardiography, the detection of valvular involvement in 90.9% of the patients exceeds the current data in our country (82.6%) and is closer to the data from our Eastern Anatolia region (86.3%). Gasimova et al.,[18] in their study conducted at Selcuk University Faculty of Medicine Hospital between 2017 and 2019, found valvular involvement in 89% of the patients, which is the closest value to my study. In the majority of patients in our study, single-valve involvement (72.7%) was observed, predominantly affecting the mitral valve (81.8%). Simultaneous involvement of the aortic and mitral valves was detected in 18.1% of the patients. Evaluation of clinical and transthoracic echocardiography findings in patients with acute rheumatic fever in studies conducted in various countries around the world and in our country has consistently identified the mitral valve as the most commonly affected valve, as in our study.[9,16,17,20,29,30,32,34,36] Simultaneous involvement of the aortic and mitral valves has been found in studies conducted in our country with percentages of 17.6%, 24.4%, 33.9%, 44.4%, and 45.5%, which are mostly higher than our data.[16,17,20,31,33] Considering global data, Kaewpechsanguan et al.,[35] in their study with 81 children in Thailand, found dual-valve involvement in 72.8% of the patients, while Alam et al.,[32] in their study with 100 patients in Bangladesh, found this rate to be 12%, similar to my study. Although not detected in our study and most studies conducted in our country, tricuspid regurgitation due to ARF has been reported in a wide range of 2-44% in the literature.[16,22,30]

In our study, complete resolution of mild mitral regurgitation was observed in 45.5% of the patients, and complete resolution of mild aortic regurgitation was observed in 66.6% of the patients. Yılmaz et al.[16] found that in 65 patients with ARF followed for an average of 12 months, mitral regurgitation improved in 21.4% of the patients and aortic regurgitation improved in 40% of the patients, without specifying the degree of regurgitation. In another study conducted with 55 patients in our country, it was found that mitral regurgitation improved in 6.1% of the patients and aortic regurgitation improved in 36.6% of the patients.[18] The low rate of improvement in mitral valve regurgitation in this study does not seem consistent with both my study and the literature data. In another study conducted in our country, which included 160 patients over seven years, it was found that mild mitral regurgitation completely resolved in 45% of the patients, and aortic regurgitation completely resolved in 55.9% of the patients, consistent with my study.[31] Considering data from other countries, in a study evaluating 75 patients, it was found that after treatment, regurgitation decreased by 64% in all patients without specifying the valve.[21] Kaewpechsanguan et al.[35] found that after one year of follow-up, 43.4% of patients with moderate to severe mitral regurgitation and 41.7% of patients with moderate to severe aortic regurgitation regressed to clinically insignificant mild regurgitation. However, in the same study, it was also shown that 4.3% of initially clinically insignificant mild mitral regurgitation and 3.6% of initially clinically insignificant mild aortic regurgitation progressed to clinically significant regurgitation.

Limitations

The number of patients included in the study is one of the limiting factors. Although the population density of the district where the study was conducted is higher than many other cities in Turkiye, ultimately it is a district in Istanbul. Another shortcoming of the study is the relatively short follow-up period. There are studies in the literature covering 8 to 27 years.[29,30]

CONCLUSION

Acute rheumatic fever remains an important health problem in childhood in our country, and even in a district of Istanbul, which is one of the largest cities in our country. While the majority of the data in our study are consistent with the literature, attention has been drawn to the challenges associated with the low socioeconomic status of our patient population. It is believed that with the increase in socioeconomic status in our country, as in developed countries around the world, the incidence of the disease will decrease.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Sancaktepe Şehit Prof. Dr. İlhan Varank Training and Research Hospital Scientific Researches Ethics Committee (Date:05.07.2023, Decision No: 2023-25).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The author has no conflicts of interest to declare.

Financial Disclosure

The author declared that this study has received no financial support.

Author Contributions

The author declares that he has all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author.

REFERENCES

1. Seckeler MD, Hoke TR. The worldwide epidemiology of acute rheumatic fever and rheumatic heart disease. *Clin Epidemiol*. 2011;3:68-84.
2. Tibazarwa KB, Volmink JA, Mayosi BM. Incidence of acute rheumatic fever in the world: a systematic review of population-based studies. *Heart*. 2008;94(12):1534-1540.
3. Gewitz MH, Baltimore RS, Tani LY, et al. Revision of the Jones criteria for the diagnosis of the rheumatic fever in the era of Doppler echocardiography: a scientific statement of the American Heart Association. *Circulation*. 2015;131(20):1806-1818.
4. Carapetis JR, Steer AC, Mulholland EK, Weber M. The global burden of group A streptococcal diseases. *Lancet Infect Dis*. 2005;5(11):685-694.
5. Oliver J, Baker MG, Pierse N, Carapetis J. Comparison of approaches to rheumatic fever surveillance across Organisation for Economic Cooperation and Development countries. *J Pediatr Child Health*. 2015;51(11):1071-1077.
6. Saraçlar M, Ertuğrul A, Özme S. Akut romatizmal ateş, insidansı ve romatizmal kalp hastalıkları prevelansı. *Türk Kardiyol Dern Arş*. 1978;7:50-54.
7. Beyazova U, Benli D, Beyazova M. Akut romatizmal ateş, görülme sıklığı. *Çocuk Sağ Hast Der*. 1987;2:76-80.
8. Karademir S, Demirçeken F, Atalay S, Demircin G, Sipahi T, Teziç T. Acute rheumatic fever in children in the Ankara area in 1990-1992 comparison with previous study in 1980-1989. *Acta Paediatr*. 1994;83(8):862-865.
9. Örün UA, Ceylan Ö, Bilici M, et al. Acute rheumatic fever in the Central Anatolia Region of Turkey: a 30-year experience in a single center. *Eur J Pediatr*. 2012;171(2):361-368.
10. Narin N, Mutlu F, Argun M, et al. Incidence and clinical features of acute rheumatic fever in Kayseri, Central Anatolia, 1998-2011. *Cardiol Young*. 2015;25(4):745-751.
11. Gürses D, Koçak G, Tutar E, Özbarlas N, Turkish ARF study group. Incidence and clinical characteristics of acute rheumatic fever in Turkey: Results of a nationwide multicentre study. *J Paediatr Child Health*. 2021;57(12):1949-1954.
12. Türkiye İstatistik Kurumu. 2021 Nüfus ve Konut Sayımı. Available from: https://data.tuik.gov.tr/Bulten/Index?p=Population-and-Housing-Census-2021-45866
13. Acar S, Karagöz T, Meydan CM, Cinoğlu DŞ, Kayğısız G, Işık M. İlçelerin Sosyo-ekonomik Gelişmişlik Sıralaması. Republic of Türkiye Ministry of Industry and Technology. SEGE/2022. General Diroctorate of Development Agencies. No: 35. Research Report No: 8. February 2022, Ankara. ISBN: 978-605-7679-34-5. Available from: https://www.sanayi.gov.tr/assets/pdf/birimler/2022-ilce-sege.pdf
14. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Smith GD. Indicators of socioeconomic position (part 1). *J Epidemiol Community Health*. 2006;60(1):7-12.
15. Kut A, Salgür F. Sağlık alanında sosyoekonomik düzey belirleme: tıbbi araştırmalarda doğru uyguluyor muyuz? *Türk Aile Hek Derg*. 2015;19(1):4-13.
16. Yılmaz İ, Güvenç O, Yılmaz FH, Çimen D, Arslan D, Oran B. Akut romatizmal ateş tanısı konulan hastaların klinik özellikleri ve ekokardiyografik bulguları. *Selçuk Tıp Derg*. 2015;31(2):73-76.
17. Keskin M. Difficulties in the diagnosis of acute rheumatic fever without carditis. *Med J Süleyman Demirel Univ*. 2020:27(3):353-357. doi: 10.17343/sdutfd.712570
18. Gasımova N, Sert A. Inflammatory biomarkers and echocardiographic findings in acute rheumatic fever patients. *J Contemp Med*. 2023;13(3):514-521.
19. Güler M, Laloğlu F, Olgun H, Ceviz N. Clinical characteristics of pediatric patients with first-attack acute rheumatic fever following the updated guideline. *Türk Pediatri Arş*. 2019; 54(4):220-224.
20. Çağatay D, Yıldız F, Temel Ö, Arslan Ö , İnalhan M. Akut romatizmal ateş: klinik bir değerlendirme. *J Child*. 2010; 10(4):183-189.
21. Baker MG, Gurney J, Oliver J, et al. Risk factors for acute rheumatic fever: literature review and protocol for a case-control study in New Zealand. *Int J Environ Res Public Health*. 2019; 15;16(22):4515.
22. Silvilairat S, Sornwai A, Sethasathien S, et al. Outcome following acute and recurrent rheumatic fever. *Paediatr Int Child Health*. 2024;44(1):13-17.
23. Parks T, Narube L, Perman ML, et al. Population-based assessment of cardiovascular complications of rheumatic heart disease in Fiji: a record-linkage analysis. *BMJ Open*. 2023; 13(4):e070629.
24. Stacey I, Hung J, Cannon J, et al. Long-term outcomes following rheumatic heart disease diagnosis in Australia. *Eur Heart J Open*. 2021;1(3):oeab035.
25. Coffey PM, Ralph AP, Krause VL. The role of social determinants of health in the risk and prevention of group A streptococcal infection, acute rheumatic fever and rheumatic heart disease: a systematic review. *PLoS Negl Trop Dis*. 2018;12(6):e0006577.
26. Narang R, Saxena A, Ramakrishnan, Gupta KS, Juneja R, Kothari SS. Characteristics of children with acute rheumatic carditis from a high-incidence region: importance of unexplained worsening of functional class. *Cardiology*. 2020;145(8):522-528.
27. Bhardwaj R, Sood A. Clinical profile of acute rheumatic fever patients in a tertiary care institute in present era. *J Assoc Physicians India*. 2015;63(4):22-24.
28. Currie B, Ralph A, eds. The 2020 Australian guideline for prevention, diagnosis and management of acute rheumatic fever and rheumatic heart disease. 3.2 edition, March 2022. Available from: https://www.rhdaustralia.org.au/system/files/fileuploads/arf_rhd_guidelines_3.2_edition_march_2022.pdf
29. Loizaga SR, ArthurL, Arya B, et al. Rheumatic heart disease in the United States: forgotten but not gone. *J Am Heart Assoc*. 2021;10(16):e020992.
30. Tal R, Saied MH, Zidani R, et al. Rheumatic fever in a developed country – is it still relevant? A retrospective, 25 years follow-up. *Pediatr Rheumatol*. 2022;20(1):20
31. Yavrum BE, Gul AEK, Azak E, Gursu HA, Cetin II. Changing face of acute rheumatic fever in childhood and our clinical results. *North Clin Istanb*. 2023;10(2):237-247.
32. Alam S, Hye MA, Ahmed S, et al. Subclinical carditis in acute rheumatic fever: a single center experience. *Cardiol Cardiovasc Med*. 2023;7(4):311-315.
33. Erol N, Özen M, Bozaykut A. A major diagnostic criterion for acute rheumatic fever: clinical and sub-clinical carditis accompaniment with Sydenham chorea. *Zeynep Kamil Med J*. 2021;52(4):198-201.
34. Ekure EN, Amadi C, Sokunbi O, et al. Echocardiographic screening of 4107 Nigerian school children for rheumatic heart disease. *Trop Med Int Health*. 2019;24(6):757-765.
35. Kaewpechsanguan A, Chungsomprasong P, Durongpisitkul K, et al. Manifestations of rheumatic carditis, regression of valvular regurgitation, and independent predictors of mitral regurgitation improvement after rheumatic carditis in thai children. *Global Heart*. 2024;19(1):16.
36. Erdem S, Demir F, Ayana M, et al. Acute rheumatic fever in south-east of Turkey: clinical features and epidemiological evaluation of the patients over the last 25 years. *Cardiol Young*. 2020;30(8):1086-1094.