

ORIGINAL ARTICLE

THIRTY YEARS TREND OF RHEUMATIC HEART DISEASES, PAKISTAN CHAPTER: INSIGHTS FROM THE GLOBAL BURDEN OF DISEASE STUDY

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Objectives: The objective of this study was to determine the 30 years (1990 to 2019) trends of rheumatic heart diseases (RHD) in terms of estimated prevalence, deaths, and disability-adjusted life years (DALYs) for Pakistan.

Methodology: This ecological study consisted of an analysis of data extracted from the Global Burden of Disease Study, which consisted of 30 years (from 1990 to 2019) trend of RHD for Pakistan in terms of prevalence, DALYs, and deaths in terms of the estimated number of cases and age-standardized rate (ASR) per 100,000 population.

Results: The prevalence of RHD has shown a 134.1% increase from 705,795 [535866.8-888749] to 1,652,438 [1261501.8-2090104.2] in 1990 to 2019 with an IRR of 1.029 [1.027-1.030]. The ASR per 100,000 population has also shown a 17.9% increase with an IRR of 1.005 [1.003-1.006]. The estimated number of deaths has shown a 39.1% increase from 15,199 [11398.2-20008] to 21,137 [15639.5-27308.1] in 1990 to 2019 with an IRR of 1.008 [0.979-1.037]. However, the ASR per 100,000 population has shown 30.0% decline with IRR of 0.984 [0.981-0.988]. Similarly, the estimated number of DALYs has shown a 57.4% increase with an IRR of 1.012 [1.009-1.015]. However, the ASR per 100,000 population has shown 20.7% decline with IRR of 0.989 [0.986-0.992].

Conclusion: The prevalence, DALYs, and deaths due to RHD in Pakistan have increased in the past 30 year's period with a significant per year percentage increase. However, age-standardized mortality and DALYs rate per 100,000 population have shown a significant per year percentage decline.

Keywords: South Asia, burden, cardiovascular diseases, GBD

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INTRODUCTION

Valvular damage is a long-term sequel of acute rheumatic fever (ARF), an auto-immune response to the group A streptococcal infection, known as rheumatic heart disease (RHD) is almost eradicated from the high-income societies.^{1,2} It is considered to be the disease associated with poverty and even in the twenty-first century, it remained a major contributor to the annual morbidities and mortalities in the low- and middle-income countries.^{3,4} Annual deaths due to RHD are estimated to be approximately 306 thousand and more than 40.5 million individuals are affected by RHD.⁵ Even though our understanding of RHD and its pathogenesis has evolved significantly in the recent times, no significant improvement and advancement have been witnessed in the preventive aspects of RHD. In the absence of an effective vaccine, surgery and penicillin-based treatment remained the primary control program of RHD. However, the adoption of

echocardiographic algorithms for screening significantly improved RHD diagnosis accuracy.⁶

Understanding regional dynamics is equally important in order to formulate actionable policies pertinent to the regional requirements and challenges. Poverty itself is the key factor in the persistent prevalence of RHD in developing and under-developing nations, overcrowding, and poor living conditions coupled with a lack of organized community-based screening and surveillance systems for rheumatic fever and pharyngitis aggravated the burden of diseases.⁷ Secondly, precise estimation of disease burden is another challenge due to the paucity of high-quality reliable epidemiological studies from these regions. Understanding the underlying disease patterns and reliable projections are vital to combat the growing burden RHD of in this region. Therefore, the objective of this study was to analyze the 30 years (1990 to 2019) trends of rheumatic heart diseases (RHD) in

terms of estimated prevalence, deaths, and disability-adjusted life years (DALYs) for Pakistan.

METHODOLOGY

This ecological study consisted of an analysis of data extracted from the Global Health Data Exchange query tool.⁸ Data set consisted of 30 years (from 1990 to 2019) trend of rheumatic heart disease (RHD) for Pakistan in terms of prevalence, disability-adjusted life years (DALYs), and deaths in terms of the estimated number of cases and Age-standardized rate per 100,000. The estimates were further stratified by gender and by age groups. A complete methodological detail used by the Global Burden of Diseases (GBD) study for the estimation of statistics is reported elsewhere.⁹

Data were analyzed with the help of Microsoft Excel 2013 and statistical software R (version 4.3.2). Percentage change in prevalence and deaths over 30-years was calculated for the year 2019 against 1990 as benchmark. Poisson regression analysis was also performed to evaluate the trends in prevalence,

disability-adjusted life years (DALYs), deaths due to RHD in Pakistan, and the incidence rate ratio (IRR) along with a 95% confidence interval was reported as an indicator of per year percentage change.

RESULTS

Thirty years trend of estimated prevalence and deaths in Pakistan due to RHD has shown increasing trends at the overall level as well as in both genders (Figure 1). The number of prevalent cases of RHD in Pakistan has shown a 134.1% increase from 705,795 [95% CI: 535866.8 to 888749] in the year 1990 to 1,652,438 [95% CI: 1261501.8 to 2090104.2] in the year 2019 with an IRR of 1.029 [95% CI: 1.027 to 1.030] showing a significant per year percentage increase. Female gender accounts for 55.8% of the total estimated RHD cases in 2019 with age distribution of 24.1% under 20 years, 15.1% between 20 and 24 years, 52.2% between 25 and 49 years, and the remaining 8.6% ≥ 50 years. The age-standardized prevalence rate per 100,000 population has also shown a 17.9% increase over the period of 1990 to 2019 with an IRR of 1.005 [95% CI: 1.003 to 1.006] showing a significant per year percentage increase (Table 1).

Table 1: Total estimated rheumatic heart disease prevalence, age-standardized prevalence rates, and percentage of change in Pakistan from 1990 to 2019

	Prevalence					Age-standardized prevalence rate per 100,000				
	1990		2019		Change (%)	1990		2019		Change (%)
	N	95% CI	N	95% CI		Rate	95% CI	Rate	95% CI	
Rheumatic heart disease	705795	535866.8-888749	1652438	1261501.8-2090104.2	134.1	625.5	474.9-787.6	737.5	563-932.8	17.9
Gender wise										
Male	327394	247170.7-412649.6	730604	553905.6-934033	123.2	553.8	418.1-698	636.2	482.3-813.3	14.9
Female	378401	287252.9-477749.3	921834	704384.3-1156551.8	143.6	704.4	534.8-889.4	844.0	644.9-1059	19.8
Age wise										
<20 years	191953	120239.1-280913.8	397736	251320.9-585305.5	107.2	306.9	192.2-449.1	355.5	224.7-523.2	15.9
20 to 24	107096	73994.9-142516.4	249984	175740.3-333318.6	133.4	1111.1	767.7-1478.6	1183.4	831.9-1577.8	6.5
25 to 49	343978	257698-438055.2	862408	651548-1100009	150.7	1222.6	915.9-1556.9	1308.1	988.3-1668.5	7.0
50 to 74 years	59445	45145.1-77280.6	137011	104015.9-180590.2	130.5	548.3	416.4-712.8	602.8	457.7-794.6	9.9
75 plus	3323	2465.1-4526.2	5299	3885.2-7248.7	59.5	198.5	147.2-270.3	219.4	160.9-300.1	10.5

The estimated number of deaths due to RHD in Pakistan has shown a 39.1% increase from 15,199 [95% CI: 11398.2 to 20008] in the year 1990 to 21,137 [95% CI: 15639.5 to 27308.1] in the year 2019 with an IRR of 1.008 [95% CI: 0.979 to 1.037] showing a significant per year percentage increase. However, the

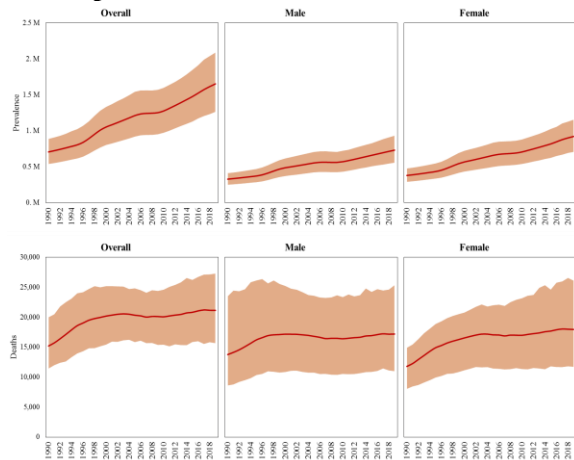
age-standardized mortality rate per 100,000 population has shown 30.0% decline over the period of 1990 to 2019 with an IRR of 0.984 [95% CI: 0.981 to 0.988] showing a significant per year percentage decline (Table 2).

Table 2: Total estimated rheumatic heart disease deaths, age-standardized mortality rates, and percentage of change in Pakistan from 1990 to 2019

	Deaths					Age-standardized mortality rate per 100,000				
	1990		2019		Change (%)	1990		2019		Change (%)
	N	95% CI	N	95% CI		Rate	95% CI	Rate	95% CI	
Rheumatic heart disease	15199	11398.2-20008	21137	15639.5-27308.1	39.1	13.5	10.1-17.7	9.4	7-12.2	-30.0
Gender wise										
Male	7341	4577.8-12538.6	9169	5846.8-13531.6	24.9	12.4	7.7-21.2	8.0	5.1-11.8	-35.7
Female	7858	5341.1-9948.3	11967	7796.3-17409.9	52.3	14.6	9.9-18.5	11.0	7.1-15.9	-25.1
Age wise										
<20 years	1302	858-1836.3	2101	1544.2-2723	61.3	2.1	1.4-2.9	1.9	1.4-2.4	-9.8
20 to 24	636	453.9-864.3	1198	817.1-1679.2	88.4	6.6	4.7-9	5.7	3.9-7.9	-14.0
25 to 49	4072	2950.9-5360.3	6892	4410.5-9559.5	69.3	14.5	10.5-19.1	10.5	6.7-14.5	-27.8
50 to 74 years	6008	4274.2-8673.1	7693	5484.9-10299.7	28.0	55.4	39.4-80	33.8	24.1-45.3	-38.9
75 plus	3181	2185.9-4918.3	3252	2473.6-4075.5	2.2	190.0	130.6-293.8	134.6	102.4-168.7	-29.1

Similarly, the estimated number of DALYs due to RHD in Pakistan has shown a 57.4% increase from 589,561 [95% CI: 449736.9 to 747504.3] to 927,937 [95% CI: 687813.9 to 1173407.2] in the year 1990 to 2019 with an IRR of 1.012 [95% CI: 1.009 to 1.015] showing a significant per year percentage increase. However, the age-standardized DALYs rate per 100,000 population has shown 20.7% decline over the period of 1990 to 2019 with an IRR of 0.989 [95% CI: 0.986 to 0.992] showing a significant per year percentage decline (Table 3).

Figure 1: Thirty years trend of rheumatic heart disease prevalence and deaths in Pakistan



Impact of the interaction between LVEF and LVEDP in predicting CIN is presented in Figure 2. The incidence of CIN in patients with $\leq 40\%$ LVEF increased from 8.2% to 18.3% at LVEDP of < 20 mmHg and ≥ 20 mmHg respectively, while, this increment with respect to incremental LVEDP was marginal (13.0% to 15.3%) for patients with LVEF of more than 40%.

DISCUSSION

Pakistan is a developing country with over 220 million population who are at an increased risk of RHD. However, due to the lack of an organized healthcare structure, the true burden of RHD is mainly not known. Therefore, in this study, we have summarized the 30 years estimates of the Global Burden of Disease Study regarding the burden of RHD in Pakistan. Not to our surprise, the prevalence of RHD in our population is rising, roundabout 134% increase in the estimated number of RHD cases has been witnessed during 30 years period from 1990 to 2019. Although, an increase in the number of RHD cases can be attributed to the population growth during the same period, but nearly 18% of increase in the age-standardized prevalence rate per 100,000 population with a significant per year percentage increase is alarming. The estimated number of deaths due to RHD also showed a 39.1% increase, however, the age-standardized mortality rate per 100,000 population showed a significant reduction (30.0%) during 30

years period. The reduction in mortality can be partly attributed to the advancements in the management of RHD and increased availability of affordable and effective secondary preventive measures in the past

three decades. Nevertheless, the estimated number of DALYs due to RHD also showed an increase of more than 57%.

Table 3: Total estimated rheumatic heart disease disability-adjusted life years (DALYs), age-standardized DALYs rates, and percentage of change in Pakistan from 1990 to 2019

	Disability-adjusted life years (DALYs)					Age-standardized DALYs rate per 100,000				
	1990		2019		Change (%)	1990		2019		Change (%)
	N	95% CI	N	95% CI		Rate	95% CI	Rate	95% CI	
Rheumatic heart disease	589561	449736.9-747504.3	927937	687813.9-1173407.2	57.4	522.5	398.6-662.5	414.1	307-523.7	-20.7
Gender wise										
Male	271423	183305.4-415434.9	415312	282764.3-597814.8	53.0	459.1	310.1-702.7	361.6	246.2-520.5	-21.2
Female	318137	223726.4-415795.6	512626	339539-733261.8	61.1	592.3	416.5-774.1	469.4	310.9-671.4	-20.8
Age wise										
<20 years	111402	75411.4-154635.7	178981	135711.4-227524.1	60.7	178.1	120.6-247.2	160.0	121.3-203.4	-10.2
20 to 24	47447	34558.8-63084.8	91706	65743.6-123084.1	93.3	492.3	358.5-654.5	434.1	311.2-582.6	-11.8
25 to 49	222410	164402-289804.5	393279	263929.7-526542.6	76.8	790.5	584.3-1030	596.5	400.3-798.7	-24.5
50 to 74 years	169833	121954.1-241695.1	224430	159782.2-302352.4	32.1	832.1	597.5-1184.2	517.7	368.6-697.4	-37.8
75 plus	38469	26417.8-59378.7	39541	30001.2-49671.9	2.8	1554.9	1067.8-2400.1	1127.5	855.5-1416.4	-27.5

There are three types of major factors affecting the distribution and burden of RHD, first and foremost environmental factors such as overcrowding, socioeconomic status, unsanitary conditions, access to medical care, poor nutritional status, etc., secondly host and genetic factors, and finally the type of organism.¹⁰ Young individuals are most affected by the RHD, as evident from the results of this study that 24.1% of RHD cases were under 20 years, while a majority (75.6%) of the cases were from 20 to 49 years of age group. Hence, effecting the productive years of the workforce of a community which in turn adversely affects the economy of a country.⁷ A fundamental prerequisite for establishing any preventive policy for RHD is to establish the true burden of diseases in the first place.¹¹ Interventions and policies for systematic tackling of environmental factors such as promoting better living conditions, hygiene, sanitation, and increasing access to quality health care are the most effective preventive measures for RHD.^{12,13}

A very limited community-based and clinical data with national coverage are available for RHD in Pakistan. Among a handful of studies, Sadiq M et al.¹⁰ reported screening and clinical examination data of 24,980 school-going children of 5 to 15 years of age

from 70 urban and semi-urban schools in Lahore, Pakistan. The prevalence of RHD in this study was 2.2% (546/24,980) with more than 90% not aware of the disease. Rizvi SF et al.¹⁴ conducted a study on a representative sample of the rural population of a single district of Punjab, Pakistan. In the screening of 9,430 individuals, a total of 54 confirmed RHD cases were identified with a prevalence rate of 0.57% with less than 20% awareness of the condition. Adnan G et al.¹⁵ screened 1773 school-going male children in urban areas of Peshawar and confirmed RHD in three children. A meta-analysis by Kumar M et al.¹⁶ reported RHD prevalence as 15.8 per 1009 subjects in the analysis of over 2000 individuals between 6 to 15 years of age. Riaz A et al.¹⁷ conducted a case-control study in a clinical setting and evaluated the quality of life of patients with RHD in comparison to healthy individuals and reported considerably impaired quality of life. Hence, reliable national representative estimates of the burden of RHD in the Pakistani population are extremely important for the policy initiatives to curtail the increasing burden of diseases in our population.

Even though this study was conducted based on estimates produced by the GBD study with technically

sound analytical methods, certain limitations need mentioning, The GBD estimates are based on the existing literature, hence, considering the lack of reliable national representative studies the data used by GBD methodology may be inaccurate in the first place.

CONCLUSION

In conclusion, the prevalence, DALYs, and deaths due to RHD in Pakistan have increased in the past 30-year's period with a significant per year percentage increase. However, age-standardized mortality and DALYs rate per 100,000 population have shown a significant per year percentage decline. Mass-level people-centered preventive and screening initiatives at the national level are needed to curtail the increasing prevalence of RHD in our population.

AUTHORS' CONTRIBUTION

MNK, BA, HM, IT, MH, MS, AR, and ZUR: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work.

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REFERENCES

1. Watkins DA, Johnson CO, Colquhoun SM, Karthikeyan G, Beaton A, Bukhman G, et al. Global, regional, and national burden of rheumatic heart disease, 1990–2015. *N Engl J Med*. 2017;377(8):713-22.
2. Marijon E, Mirabel M, Celermajer DS, Jouven X. Rheumatic heart disease. *Lancet*. 2012;379(9819):953-64.
3. Remenyi B, ElGuindy A, Smith Jr SC, Yacoub M, Holmes Jr DR. Valvular aspects of rheumatic heart disease. *Lancet*. 2016;387(10025):1335-46.
4. Murray CJ, Barber RM, Foreman KJ, Ozgoren AA, Abd-Allah F, Abera SF, et al. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990–2013: quantifying the epidemiological transition. *Lancet*. 2015;386(10009):2145-91.
5. Roth GA, Mensah GA, Johnson CO, Addolorato G, Ammirati E, Baddour LM, et al. Global burden of cardiovascular diseases and risk factors, 1990–2019: update from the GBD 2019 study. *J Am Coll Cardiol*. 2020;76(25):2982-3021.
6. Woldeu B, Bloomfield GS. Rheumatic heart disease in the twenty-first century. *Curr Cardiol Rep*. 2016;18(10):1-1.
7. Negi PC, Sondhi S, Asotra S, Mahajan K, Mehta A. Current status of rheumatic heart disease in India. *Indian Heart J*. 2019;71(1):85-90.
8. Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2019 (GBD 2019) Results. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2020. Available from: <http://ghdx.healthdata.org/gbd-results-tool>.
9. Murray CJ, Lopez AD, Mathers CD, Stein C. The Global Burden of Disease 2000 project: aims, methods and data sources. Geneva: WHO. 2001;36:1-57.
10. Sadiq M, Islam K, Abid R, Latif F, Rehman AU, Waheed A, et al. Prevalence of rheumatic heart disease in school children of urban Lahore. *Heart*. 2009;95(5):353-7.
11. Dougherty S, Beaton A, Nascimento BR, Zühlke LJ, Khorsandi M, Wilson N. Prevention and control of rheumatic heart disease: Overcoming core challenges in resource-poor environments. *Ann Pediatr Cardiol*. 2018;11(1):68-78.
12. Ramakrishnan S, Juneja R. Rheumatic heart disease in India: 'Buried alive'. *Natl Med J India*. 2014;27(2):65-9.
13. Carapetis JR, Beaton A, Cunningham MW, Guilherme L, Karthikeyan G, Mayosi BM, et al. Acute rheumatic fever and rheumatic heart disease. *Nat Rev Dis Primers*. 2016;2(1):1-24.
14. Rizvi SF, Khan MA, Kundi A, Marsh DR, Samad A, Pasha O. Status of rheumatic heart disease in rural Pakistan. *Heart*. 2004;90(4):394-9.
15. Adnan G, Mohammad H. Rheumatic heart disease in urban school children of Peshawar. *J Postgrad Med Inst*. 2009;23(4):337-40.
16. Kumar M, Khokhar NA, Bano S, Shah SA, Abrar M, Kalhor MA. Prevalence of rheumatic heart disease in Pakistan: a meta-analysis study. *J Res Med Dent Sci*. 2022;10:79-81.
17. Riaz A, Hanif MI, Khan IH, Hanif A, Mughal S, Anwer A. Quality of life in patients with rheumatic heart disease. *J Pak Med Assoc*. 2018;68(3):370-5.

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