

# The Local Burden of Disease for Non-Rheumatic-Acquired Valvular Heart disease in Iran, North Africa and Middle East from 1990 to 2017: Findings from a Sub-Analysis of the Global Burden of Disease Study 2017

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## Research article

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## Abstract

**Background:** Cardiovascular diseases (CVDs) are one of the main causes of mortality and a major barrier to sustainable development, being the main cause of “Disability-Adjusted Life Years” (DALYs), “Years of Life lost” (YLLs) and “Years Lived with Disability” (YLDs). Among CVDs, one of the most common and treatable CVD is non-rheumatic-acquired valvular heart disease (NRVD). However, in some countries such as Iran, the burden of NRVD is almost unknown because previous studies have focused mostly on the burden of ischemic heart disease, heart failure and other cardiovascular diseases.

**Method:** Using data from the 2017 “Global Burden of Disease study”, we compared the number of deaths, DALYs, YLLs, YLDs, incidence and prevalence trends for NRVD in Iran, North Africa and Middle East since 1990 to 2017.

**Results:** Our study yielded 3 major results: 1) a higher rate of death in Iran compared with North Africa, the Middle East and globally; 2) a higher increase in DALYs, YLLs, and YLDs in Iran in comparison with North Africa, the Middle East, and globally from 1990 to 2017; and 3) vast differences in increasing rates of prevalence and incidence of NRVD in Iran compared with the global trends from 1990 to 2017. The significant difference in the prevalence rate of NRVD in Iran versus global rate can be due to the higher growth rates of aging and the co-morbidities associated with NRVD, such as hypertension.

**Conclusion:** Iranian health policy- and decision-makers should allocate significant resources for their diagnosis, treatment and management.

## Introduction

According to the third goal of the Sustainable Development Goals (SDGs) settled by the United Nations, ensuring health, by promoting healthy lifestyles and well-being at all ages, is of paramount importance to achieve a sustainable human development (1). Cardiovascular diseases (CVDs) are one of the main causes of mortality and a major barrier to sustainable development (1, 2). More in detail, in 2017, CVDs represented the main cause of “Years of Life lost” (YLLs) (3). Among CVDs, one of the most common and treatable CVD is non-rheumatic-acquired valvular heart disease (NRVD) (4, 5): aortic and mitral valve disease affects up to 2.5% of the USA population (5, 6).

The “Global Burden of Diseases, Injuries, and Risk Factors Study 2017” (GBD 2017) performed a comprehensive and systematic assessment of incidence and prevalence rates, “Disability-Adjusted Life Years” (DALYs), YLLs and “Years Lived with Disability” (YLDs), for 354 disorders, including NRVD, in 195 countries and territories from 1990 to 2017, with estimates broken down by age and sex (7, 8, 9). More in detail, according to the study, 1.5 million and 1.1 million DALYs were lost due to calcific aortic and degenerative mitral valve diseases across the world, respectively, representing 0.12% of the total health lost from all diseases in 2017 (4, 8).

Nkomo and colleagues performed a population-based study in 2006, computing the burden of valvular heart diseases. Authors found that the prevalence rate of valvular heart diseases increased with age, from 0.7% in the 18–44 years to 13.3% in the 75 years and older age group (5).

Coffey and coworkers have performed a systematic review of the literature and meta-analysis to compute the prevalence, incidence, and progression rates, and risks of aortic valve sclerosis, finding that the prevalence of aortic valve sclerosis increased according to the age, ranging from 9% in the 54 years to 42% in the 81 years. In total, 1.8% to 1.9% of participants with aortic valve sclerosis is expected to progress to clinical aortic stenosis *per* year (10).

In some countries such as Iran, the burden of NRVD is almost unknown because previous studies have focused mostly on the burden of ischemic heart disease, heart failure and other cardiovascular diseases.

We hypothesized that NRVDs are highly prevalent and represent a public-health problem in developing countries. To the best of our knowledge, no study has ever been done to comprehensively compare the burden of NRVD in Iran, North Africa and the Middle East, stratifying incidence, prevalence, mortality rates, and overall burden of valvular heart disease by country. The present study can provide detailed information to policy- and decision-makers in making informed, evidence-based decisions to prioritize and allocate resources for NRVDs, taking into account trade-offs and opportunities.

## Methods

Relevant data (number of deaths, DALYs, YLLs, YLDs, incidence and prevalence trends for NRVD) were extracted from the GBD 2017 report, for Iran, North Africa and the Middle East, stratified by age and sex, from 1990 to 2017.

DALYs were defined as the quantitative measurement of the overall span of years of healthy life lost due to disease (7, 8, 11). YLLs were defined as the amount of years lost due to premature mortality and were calculated by subtracting the age at death from the longest possible life expectancy (8, 11).

YLDs were computed multiplying disease prevalence by disability weighted for that condition, which reflects the severity of different conditions as assessed by means of surveys administered to the general public (7, 8).

Age-standardized rate was the rate computed *per* 100,000 population following the standardization procedure according to the global age structure irrespective of population size and age structure (7, 12).

Calcified aortic valve disease (CAVD) was defined as a clinical diagnosis of aortic valve stenosis or regurgitation due to progressive calcification of the valve or annulus leading to hemodynamically moderate or severe stenosis or regurgitation.

Degenerated mitral valve disease (DMVD) was defined as a disorder caused by a myxomatous degeneration of the mitral valve leading to hemodynamically moderate or severe regurgitation.

Other NRVD is a residual category that captures non-rheumatic, non-congenital valve disorders of the tricuspid and pulmonary valves (5).

Finally, a category of total NRVD was defined as the aggregate of the three previously mentioned categories (CAVD, DMVD, other NRVD).

NRVD-related classification was stratified to 3 age groups: from 15 to 49 years (15–49 yrs), from 50 to 69 years (50–69 yrs), and over 70 years (70+ yrs).

Moreover, it should be noted that the GBD 2017 study estimated causes of death incorporating sophisticated methods to adjust for incomplete or missing value, including vital registration (VR) and verbal autopsy (VA) data, general heterogeneity in data completeness and quality, and the redistribution of so-called garbage codes (that is to say, those insufficiently specific or implausible causes of death codes) (7).

Also the GBD 2017 study provided a standardized approach for estimating incidence, prevalence rates, DALYs, YLLs and YLDs by cause, age, sex, year, and location (13). The GBD used statistical modelling tools, including the “Cause of Death Ensemble model” (CODEm), to generate cause fractions and cause specific death rates for each location, year, age, and sex. The model computed 95% Uncertainty Interval (95% UI) for each epidemiological parameter. More in detail, the 95% UIs were derived from the 2.5<sup>th</sup> and 97.5<sup>th</sup> percentiles of 1,000 draws for each parameter. Uncertainty from all data sources imputed into the calculations of DALYs was propagated by means of Monte Carlo techniques (8, 14).

## Results

Table 1 shows the number of deaths and mortality rate for NRVDs in Iran (1990 - 2017). The crude death number for men for all ages increased by 190% (160.9 to 466.7) from 1990 to 2017. A huge portion of this increase occurred in the 70+ age group (404%). The age-standardized death rate for NRVD increased for both sexes; 10% (1.28 to 1.41) in men and 24% (1.29 to 1.60) in women from 1990 to 2017.

As reported in table 2, increase in the number of DALYs in the 15–49 years group among men was almost two-time higher than among women (100% in men and 46% in women). The age-standardized DALYs rate increased by 4% (31.6 person-year *per* 100,000 in 1990 to 32.9 person-year *per* 100,000 in 2017) for men and 0.6% (31.1 person-year *per* 100,000 in 1990 to 31.3 person-year *per* 100,000 in 2017) in women over 27 years from 1990 to 2017.

Moreover, results showed that the crude YLDs and YLL increased approximately the same in both sexes as shown in table 3 and 4. Table 4 reports the number and rate of YLDs for NRVDs in Iran. The age-standardized YLDs increased by 6.2 % (2.70 to 2.82) for men and 9% (3.0 to 3.27) in women. Also, the crude YLDs increased by 231.4 % (260.5 person-years to 863.3 *per* 100,000 over 1990 to 2017) in men and 237.4 % (290.9 person-years to 981.6 *per* 100,000 over 1990 to 2017) in women. The age-standardized rate of death decreased by 19% in both sexes (2.02 in 1990 to 1.63 in 2017) and the crude number of deaths increased by 96% (3,201.4 to 6,303) for both sexes in all ages from 1990 to 2017 in North African and Middle Eastern countries as reported in table 5.

Also, the age-standardized rate of DALYs decreased by 20.4% (46.4 to 36.9 *per* 100,000) in these countries over these years. As shown in Figure 1, the percentage of total death, DALYs and YLLs attributed to VHD increased in Iran, North Africa, the Middle East, and globally. The percentage of death attributed to VHD increased by 150 % (0.10 to 0.25) in Iran, by 69 % (0.13 to 0.22) in North Africa and the Middle East, and by 73% (0.15 to 0.26) globally over 1990 to 2017. This increase in Iran was almost two times higher than that of North Africa, the Middle East and globally. The percentage of DALYs also increased by 200 % (0.04 to 0.12), 66 % (0.06 to 0.10), and 66 % (0.06 to 0.10) in Iran, North Africa, and the Middle East, respectively. Furthermore, the percentage of YLLs increased by 250 % (0.06 to 0.21) in Iran from 1990 to 2017, which is two times higher than that of North Africa and the Middle East (128 % (0.07 to 0.16)) and three times higher than the percentage of YLLs at the global level (85 % (0.07 to 0.13)). Finally, table 7 reports the prevalence rate of VHD, which increased by 105% (95%UI, from 14,456,334.3 to 29,729,142) globally.

## Discussion

Globally, the burden of NRVD showed an increasing trend from 1990 to 2017. Our study yielded 3 major results: 1) a higher rate of death in Iran compared with North Africa, the Middle East and globally; 2) a higher increase in DALYs, YLLs, and YLDs in Iran in comparison with North Africa, the Middle East, and globally from 1990 to 2017; and 3) vast differences in increasing rates of prevalence and incidence of NRVD in Iran compared with the global trends from 1990 to 2017.

The number of crude deaths increased in all age groups for both sexes in Iran. The age-standardized rate of death increased by 10% for men and 24% for women, and this higher age-standardized rate in women can be attributed, at least partially, to the higher life expectancy of women compared with men (76.9 *versus* 74.4 for 2017).

These results are not in line with the data from North Africa and the Middle East as well as the global data. The age-standardized rate of death for both sexes decreased by 19% in North Africa and the Middle East, and by 2.9% at the global level. There is a significant difference in rate of death in Iran *versus* North Africa and the Middle East and at a global level. This difference can be due to the higher rate of aging in Iran. The rate of aging in Iran has risen from 3.34% (population aged 65 and above % of total) to 5.44% between 1990 and 2017 with a growth rate of 62.8% (15). The aging growth rate in global and in North Africa and the Middle East was 39.8% (6.15% to 8.6%) and 37.4% (3.74% to 5.14%) respectively (16). According to the data, it can be concluded that the aging rate in Iran during this time period was 1.5 times more than the global rate as well as its rate in the EMRO region.

Age-standardized DALYs in Iran increased by 2% over 1990 to 2017; however, these results are not consistent with the findings from North African and Middle Eastern countries as well as the data at the global level. Over these years, age-standardized DALYs decreased by 20% in North Africa and Middle East and by 13% at the global level. Also, age-standardized YLLs increased by 1.3% in Iran, but it decreased by 16.2% at the global level over 1990 to 2017. Furthermore, age-standardized YLDs increased by 6.9% for both sexes in Iran; however, there was a 5% reduction in age-standardized YLDs at the global level and a 6% increase for North Africa and the Middle East over 1990 to 2017.

The percentage of total death attributed to NRVD increased by 150 % (0.1% to 0.25%) in Iran, by 69% (0.13% to 0.22%) in North Africa and Middle East and by 73% (0.15% to 0.26%) at the global level over 1990 to 2017. In addition, DALYs attributed to NRVD increased by 200% (0.04 to 0.12) in Iran, and by 66% (0.06% to 0.10%) in North Africa and Middle East and at the global level over 1990 to 2017. Also, YLLs attributed to NRVD increased by 250 % (0.06 to 0.21) in Iran, by 85% (0.07 to 0.13) at the global level, and by 128% (0.07 to 0.16) in North Africa and Middle East.

Prevalence of NRVD in all ages and for both sexes increased by 211% (55,809 to 174,071) in Iran, by 175% in North Africa and Middle East, and by 105% at the global level in 1990 to 2017. Also, the age-standardized rate of prevalence of NRVD increased similarly in Iran and North Africa and Middle East by 14.9% and 12.5%, respectively; but this increase was so slow at the global level (1.8%).

The significant difference in the prevalence rate of NRVD in Iran *versus* its global rate can be due to the higher growth rates of aging and the co-morbidities associated with NRVD, such as hypertension. For instance, in 2017, the age-standardized rate for prevalence of hypertension in Iran and at the global level was 420.38 (*per* 100,000) and 217.89 (*per* 100,000) respectively.

Age-standardized incidence rate for NRVD was very similar to its prevalence rate in all three age groups in both sex (Iran, North Africa and Middle East and at the global level).

## Conclusion

NRVDs generate a high and relevant burden in Iran, especially among the elderly. An increase in the number of deaths and DALYs in Iran can be associated with the higher rate of aging (1.5 times) and increased prevalence of risk factors such as hypertension (1.9 times) compared with the world, North Africa and Middle East.

The results of the present study indicated that, due to incremental trend in rate of death, DALYs, prevalence and incidence of NRVD in Iran, health policy- and decision-makers should allocate significant resources for early diagnosis, and management.

## Declarations

## Authors' contributions

Conceptualization: SA, NO, AR. Leading the overall coordination: SA, AZ. Data compilation and analysis: SA, JA. Writing the first draft: SA, MB, NO. Data interpretation: MB, AR. Data provision: AZ, VA, JA. Critical revision of the manuscript: SA, NO, NLB. Reading and approval of the final manuscript: All authors.

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## Conflict of interest

All authors declare that there are no conflicts of interest.

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## Tables

**Table1: Death number and mortality rate for NRVDs by age and sex in 1990 and 2017 in Iran.**

Age	Number of Deaths			Mortality Rate (per 100,000) [95% UI]		
	1990	2017	%Δ (1990-2017)	1990	2017	%Δ (1990-2017)
<b>Male</b>						
<b>15-49 years</b>	41.9 (32.2 to 53.2)	88.9 (80.6 to 124.1)	112.1	0.32 (0.24 to 0.40)	0.37 (0.34 to 0.52)	15
<b>50-69 years</b>	73.8 (62.2 to 88.7)	149.6 (124.7 to 179.3)	102.7	2.65 (2.23 to 3.18)	2.49 (2.07 to 2.98)	-6
<b>70+ years</b>	45.2 (36.2 to 54.2)	228.0 (175.3 to 255.2)	404.4	9.23 (7.40 to 11.08)	13.99 (10.76 to 15.66)	51
<b>All Ages</b>	160.9 (135.4 to 194.2)	466.7 (386.5 to 565.6)	190.0	0.55 (0.46 to 0.66)	1.12 (0.93 to 1.36)	103
<b>Age-standardized</b>	-	-	-	1.28 (1.07 to 1.53)	1.41 (1.16 to 1.67)	10
<b>Female</b>						
<b>15-49 years</b>	44.4 (35.4 to 55.9)	68.7 (63.4 to 79.8)	54	0.34 (0.27 to 0.43)	0.30 (0.27 to 0.34)	-11
<b>50-69 years</b>	51.6 (43.6 to 62.3)	121.7 (113.2 to 137.4)	135	2.13 (1.80 to 2.57)	1.99 (1.85 to 2.24)	-6
<b>70+ years</b>	52.7 (46.7 to 60.2)	299.9 (279.3 to 325.5)	469	11.0 (9.75 to 12.57)	18.4 (17.1 to 20.0)	67
<b>All Ages</b>	148.8 (126.9 to 177.0)	490.4 (462.3 to 533.5)	229	0.52 (0.45 to 0.62)	1.21 (1.14 to 1.32)	132
<b>Age-standardized</b>	-	-	-	1.29 (1.14 to 1.49)	1.60 (1.50 to 1.73)	24
<b>All Ages (both sexes)</b>	309.81 (273.33 to 363.79)	957.24 (890.24 to 1,076.31)	209	0.54 (0.47 to 0.63)	1.16 (1.08 to 1.31)	114
<b>Age-standardized (both sexes)</b>	-	-	-	1.30 (1.17 to 1.49)	1.50 (1.37 to 1.67)	<b>15.3</b>

Table2: Number and rate of DALYs for NRVDs by age and sex in 1990 and 2017 in Iran

Age	Number of DALYs			Rate of DALYs(per 100,000) [95% UI]		
	1990	2017	%Δ (1990- 2017)	1990	2017	%Δ (1990- 2017)
<b>Male</b>						
<b>15-49 years</b>	2,325.7 (1,781.6 to 2,962.6)	4,657.0 (4,220.8 to 6,537.1)	100	17.4 (13.3 to 22.2)	19.4 (17.5 to 27.2)	11.4
<b>50-69 years</b>	2,188.2 (1,848.7 to 2,638.1)	4,524.3 (3,814.9 to 5,340.4)	106	78.4 (66.3 to 94.6)	75.1 (63.3 to 88.6)	-4
<b>70+ years</b>	746.01 (622.1 to 884.9)	3,156.8 (2,587.4 to 3,583.2)	323	152.2 (126.9 to 180.6)	193.6 (158.7 to 219.8)	27.2
<b>All Ages</b>	5,260.01 (4,379.47 to 6,389.91)	12,338.1 (11,073.4 to 15,282.5)	134	17.8 (14.8 to 21.6)	29.6 (26.5 to 36.6)	66
<b>Age-standardized</b>	-	-	-	31.6 (26.7 to 38.2)	32.9 (29.2 to 40.1)	4
<b>Female</b>						
<b>15-49 years</b>	2,452.5 (1,947.6 to 3,094.8)	3,645.40 (3,345.5to 4,198.6)	48	18.7 (14.8 to 23.6)	15.6 (14.4 to 18.0)	-16.5
<b>50-69 years</b>	1,576.9 (1,336,1 to 1,885.9)	3,693.5 (3,416.3to 4,149.1)	134	64.9 (55.0 to 77.7)	60.3 (55.8 to 67.7)	-7
<b>70+ years</b>	788.9 (677.6 to 927.8)	3,829.5 (3,486.61to 4,289.7)	385	164.6 (141.4 to 193.6)	235.4 (214.3 to 263.7)	43
<b>All Ages</b>	4,818.3 (4,004.3 to 5,831.8)	11,168.4 (10,379.4 to 12,493.9)	131	16.9 (14.1 to 20.5)	27.5 (25.6 to 30.8)	62.7
<b>Age-standardized</b>	-	-	-	31.1 (26.2 to 36.8)	31.3 (29.1 to 34.9)	0.6
<b>All Ages (both sexes)</b>	10,078.3 (8,711 to 11,942.6)	23,506.6 (22,021. to 27,182.3)		17.4 (15.0 to 20.6)	28.6 (26.8 to 33.0)	
<b>Age-standardized(both sexes)</b>	-	-	-	31.5 (27.9 to 36.8)	32.1 (29.9 to 36.4)	2

Abbreviation: DALYs (Disability-Adjusted Life Years), NRVD (Non-rheumatic Valvular Heart Disease)

Table3: Number and rate of YLLs for NRVDs by age and sex in 1990 and 2017 in Iran.

Age	Number of YLLs			Rate of YLLs(per 100000) [95% UI]		
	1990	2017	%Δ (1990- 2017)	1990	2017	%Δ (1990- 2017)
<b>Male</b>						
<b>15-49 years</b>	2,309.1 (1,769.0 to 2,947.4)	4,618.3 (4,182.0 to 6,502.6)	100	17.3 (13.3 to 22.1)	30.1 (25.8 to 37.4)	73.9
<b>50-69 years</b>	2,072.1 (1,749.7 to 2,495.8)	4,294.4 (3,589.7 to 5,118.4)	107	74.3 (62.7 to 89.5)	71.3 (59.6 to 84.9)	-4
<b>70+ years</b>	618.15 (496.2 to 745.6)	2,562.0 (2,002.0 to 2,872.0)	314	126.1 (101.2 to 152.1)	157.1 (122.8 to 176.1)	24.5
<b>All Ages</b>	4,999.4 (4,147.2 to 6,103.5)	11,474.8 (10,005.5 to 14,505.8)	129	16.9 (14.0 to 20.7)	27.5 (24.0 to 34.8)	62.7
<b>Age-standardized</b>	-	-	-	28.9 (24.4 to 35.0)	30.1 (25.8 to 37.4)	4
<b>Female</b>						
<b>15-49 years</b>	2,431.4(1,930.3 to 3,079.3)	3,597.3 (3,303.68 to 4,153.61)	47	18.5 (14.7 to 23.5)	15.4 (14.2 to 17.8)	-16.7
<b>50-69 years</b>	1,461.4(1,233.5 to 1,760.6)	3,414.1 (3,170.80 to 3,838.70)	131	60.2 (50.8 to 72.5)	55.7 (51.7 to 62.7)	-7.4
<b>70+ years</b>	634.55(551.02 to 743.55)	3,175.3 (2,957.08to 3,445.59)	400	132.4 (115.0 to 155.2)	195.2 (181.7 to 211.8)	47.4
<b>All Ages</b>	4,527.3 (3,751.9to 5,530.8)	10,186.8 (9,574.6 to 11,416.4)	125	15.9 (13.2 to 19.4)	25.1 (23.6 to 28.1)	57.8
<b>Age-standardized</b>	-	-	-	28.0 (23.7 to 33.6)	28.0 (26.4 to 31.3)	0
<b>All Ages (both sexes)</b>	9,526.8 (8,178.7to 11,329.3)	21,661.6 (20,513.8 to 25,467.0)	127	16.4 (14.1 to 19.5)	26.3 (24.9 to 30.9)	60
<b>Age-standardized(both sexes)</b>	-	-	-	28.6 (25.1 to 33.7)	29.0 (27.4 to 33.7)	1.3

Table4: Number and rate of YLDs of NRVD by age and sex in 1990 and 2017 in Iran

Age	Number of YLDs			Rate of YLDs(per 100000) [95% UI]		
	1990	2017	%Δ (1990- 2017)	1990	2017	%Δ (1990- 2017)
<b>Male</b>						
<b>15-49 years</b>	16.6 (7.3 to 33.3)	38.6 (15.5 to 79.3)	132.5	0.12 (0.06 to 0.25)	0.16 (0.06 to 0.33)	33.3
<b>50-69 years</b>	116.0 (59.2 to 197.1)	229.9 (114.9 to 395.2)	98.1	4.16 (2.12 to 7.07)	3.82 (1.91 to 6.56)	-8.1
<b>70+ years</b>	127.8 (74.0 to 200.1)	594.7 (347.0 to 911.7)	365.3	26.09 (15.12 to 40.85)	36.49 (21.26 to 55.93)	40.3
<b>All Ages</b>	260.5 (146.1 to 419.3)	863.3 (491.6 to 1,363.7)	231.4	0.88 (0.50 to 1.42)	2.07 (1.18 to 3.27)	135.2
<b>Age-standardized</b>	-	-	-	2.70 (1.57 to 4.24)	2.87 (1.66 to 4.47)	6.2
<b>Female</b>						
<b>15-49 years</b>	21.1 (9.82 to 41.4)	48.0 (21.3 to 93.5)	127.4	0.16 (0.07 to 0.32)	0.21 (0.09 to 0.40)	31.2
<b>50-69 years</b>	115.4 (59.9 to 195.3)	279.3 (146.6 to 475.4)	142	4.7 (2.4 to 8.0)	4.5 (2.39 to 7.77)	-4.4
<b>70+ years</b>	154.3 (90.9 to 233.4)	654.1 (379.6 to 994.6)	323.9	32.2 (18.9 to 48.7)	40.2 (23.3 to 61.1)	24.8
<b>All Ages</b>	290.9 (163.5 to 465.2)	981.6 (562.4 to 1,533.8)	237.4	1.0 (0.58 to 1.64)	2.4 (1.3 to 3.7)	140
<b>Age-standardized</b>	-	-	-	3.0 (1.76 to 4.7)	3.27 (1.88 to 5.06)	9
<b>All Ages (both sexes)</b>	551.5 (314.0 to 883.9)	1,844.9 (1,051.4 to 2,895.4)	234.5	0.95 (0.54 to 1.53)	2.25 (1.28 to 3.52)	136.8
<b>Age-standardized(both sexes)</b>	-	-	-	2.87 (1.76 to 4.46)	3.07 (1.77 to 4.77)	6.9

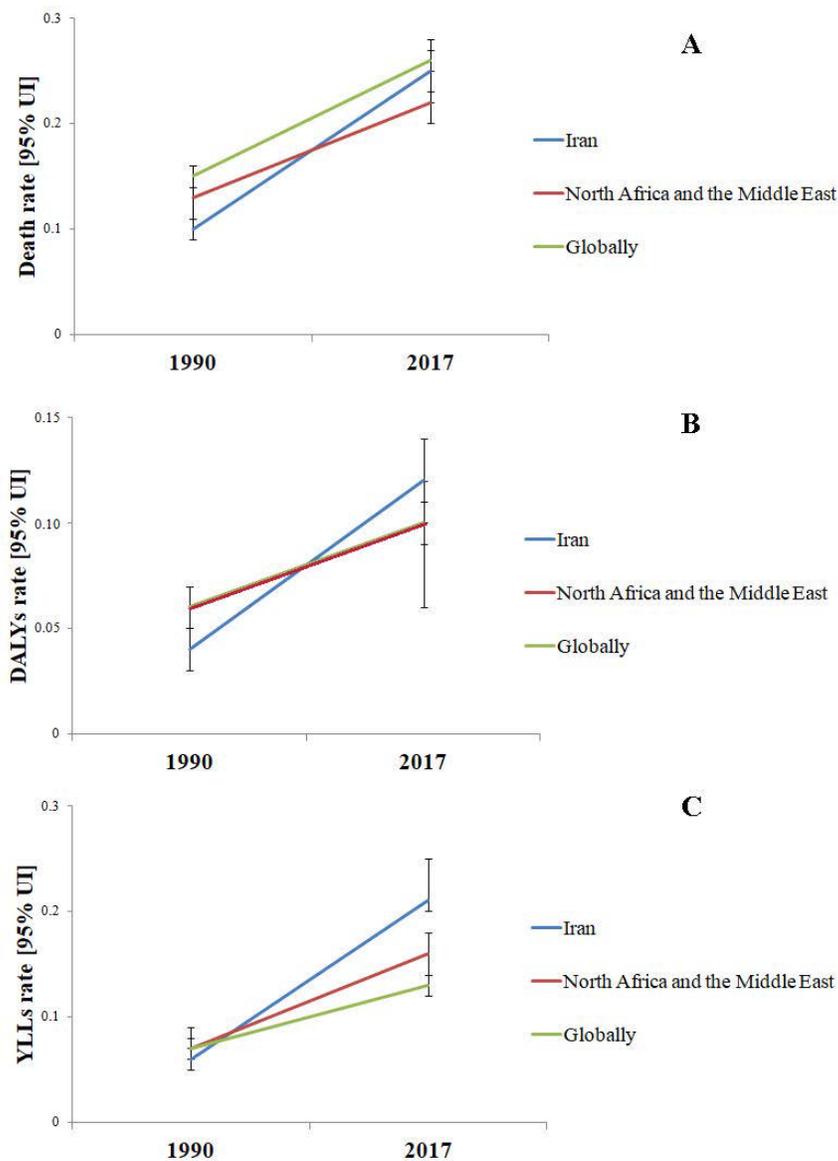
Table 5: Number of deaths and DALYs for NRVDs by age in both sexes in 1990 and 2017 in North Africa and the Middle East.

Both sexes													
	Number of Deaths				Rate of Death (per 100000)[95% UI]			Number of DALYs			Rate of DALYs(per 100000)[95% UI]		
	age	1990	2017	%Δ	1990	2017	%Δ	1990	2017	%Δ	1990	2017	%Δ
<b>North Africa and the Middle East</b>	15-49 years	780.6 (590.4 to 1,039.7)	1,278.2 (1,108.8 to 1,537.4)	63	0.48 (0.37 to 0.65)	0.39 (0.34 to 0.47)	-18.7	41,743.0 (31,530.5 to 55,354.4)	66,448.6 (57,778.1 to 79,542.1)	59	25.9 (19.5 to 34.3)	20.4 (17.7 to 24.4)	-21.2
	50-69 years	1,152.4 (957.0 to 1,429.7)	2,079.2 (1,830.1 to 2,371.7)	80	3.69 (3.07 to 4.58)	2.8 (2.47 to 3.2)	-31.7	33,979.0 (28,239.7 to 42,082.7)	62,082.6 (54,541.4 to 70,841.3)	82	108.8 (90.43 to 134.8)	83.7 (73.5 to 95.5)	-23
	70+ years	1,268.2 (1,114.1 to 1,422.0)	2,945.6 (2,698.6 to 3,202.6)	132	17.34 (15.23 to 19.44)	15.92 (14.58 to 17.31)	-8	17,985.0 (15,761.3 to 20,331.3)	41,314.6 (37,269.9 to 46,631.3)	129	245.8 (215.4 to 277.9)	233.2 (201.4 to 252.0)	-5
	All Ages	3,201.4 (2,709.5 to 3,874.0)	6,303.0 (5,746.2 to 6,977.3)	96	0.94 (0.79 to 1.14)	1.05 (0.96 to 1.16)	11.7	93,707.1 (76,263.0 to 116,797.1)	169,845.9 (152,001.7 to 191,989.2)	81	27.4 (22.3 to 34.2)	28.3 (25.3 to 31.9)	3
	Age-standardized	-	-	-	2.02 (1.76 to 2.37)	1.63 (1.49 to 1.79)	-19	-	-	-	46.4 (38.8 to 56.4)	36.9 (33.2 to 41.6)	-20.4
<b>Global</b>	15-49 years	6,951.3 (5,969.9 to 8,456.2)	9,063.8 (8,278.9 to 10,222.8)	30.3	0.25 (0.22 to 0.31)	0.23 (0.22 to 0.26)	-8	374,114.0 (317,097.1 to 457,715.5)	474,648.2 (431,754.6 to 533,340.7)	26.8	13.67 (11.59 to 16.73)	12.1 (11.0 to 13.6)	-11
	50-69 years	15,999.0 (14,713.3 to 17,636.2)	23,975.8 (22,605.4 to 26,567.9)	49.8	2.33 (2.14 to 2.57)	1.82 (1.72 to 2.02)	-21.8	479,033.1 (435,172.4 to 532,042.3)	732,716.0 (674,247.1 to 822,142.2)	52.9	69.7 (63.3 to 77.4)	55.6 (51.1 to 62.3)	-20
	70+ years	45,497.3 (41,934.9 to 51,766.6)	111,819.9 (89,404.8 to 116,761.2)	145.7	22.38 (20.63 to 25.46)	25.83 (20.60 to 26.98)	15.4	634,941.4 (569,797.0 to 717,630.6)	1,321,813.1 (1,132,225.6 to 1,486,254.3)	108.1	312.3 (280.2 to 352.9)	305.3 (261.5 to 343.3)	-2
	All Ages	68,477.6 (63,570.3 to 76,767.4)	144,859.8 (121,826.5 to 150,372.7)	115.4	1.27 (1.18 to 1.42)	1.90 (1.59 to 1.97)	49.6	1,488,088.6 (1,350,964.1 to 1,676,703.7)	2,529,177.5 (2,289,317.0 to 2,774,571.2)	69.9	27.58 (25.04 to 31.08)	33.1 (29.9 to 36.3)	20.3
	Age-standardized	-	-	-	2.03 (1.90 to 2.31)	1.97 (1.64 to 2.05)	-2.9	-	-	-	37.4 (34.0 to 41.9)	32.74 (29.5 to 35.9)	-12.5

**Table7: Prevalence and incidence of NRVD in all ages and both sexes in 1990 and 2017 in Iran, North Africa, the Middle East and globally.**

All ages and both sexes		Prevalence[95% UI]			Incidence[95% UI]		
		1990	2017	%Δ	1990	2017	%Δ
Iran	Number	55,809.04 (53,561.90 to 58,130.2)	174,071.62 (166,524.3 to 181,553.2)	211	58,597.0 (56,641.2 to 60,677.0)	180,293.8 (173,561.6 to 187,062.9)	207
	Rate(per 100,000)	96.4 (92.5 to 100.4)	211.8 (202.6 to 220.9)	119	101.2 (97.8 to 104.8)	219.4 (211.2 to 227.6)	116
	Age-standardized(per 100,000)	215.4 (206.9 to 224.3)	248.9 (238.0 to 259.9)	15	223.2 (215.4 to 231.2)	256.8 (246.6 to 267.0)	14.9
North Africa And the Middle East	Number	363,938.2 (348,941.2 to 379,607.5)	1,002,730.7 (961,898.20 to 1,045,346.2)	175	380,628.0 (367,950.6 to 394,021.0)	1,041,861.7 (1,005,003.2 to 1,080,481.3)	173
	Rate(per 100,000)	106.7 (102.3 to 111.3)	167.0 (160.2 to 174.1)	56	111.6 (107.9 to 115.5)	173.5 (167.4 to 180.0)	55
	Age-standardized(per 100,000)	213.9 (205.3 to 222.8)	241.2 (231.2 to 251.5)	12.7	221.3 (213.6 to 229.4)	249.0 (239.5 to 258.8)	12.5
Global	Number	14,456,334.3 (13,894,603.6 to 15,046,906)	29,729,142 (28,505,399.3 to 31,022,475)	105	14,934,926 (14,364,759.1 to 15,523,650.1)	30,691,206.5 (29,436,408.89 to 32,002,229.4)	105
	Rate(per 100,000)	267.9 (257.5 to 388.5)	389.1 (373.0 to 406.0)	45	276.8 (266.2 to 287.7)	401.6 (385.2 to 418.8)	45
	Age-standardized(per 100,000)	372.7 (357.5 to 388.5)	379.1 (363.5 to 395.9)	1.7	384.3 (368.8 to 400.2)	391.4 (374.9 to 408.7)	1.8

## Figures



**Figure 1**

The percentage of total death, DALYs and YLLs attributed to VHD increased in Iran, North Africa, the Middle East, and globally