The burden of gout and its attributable risk factors in the Middle East and North Africa region, 1990-2019

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Abstract

Objective: This study reported the burden of gout and its attributable risk factors, in the Middle East and North Africa (MENA) region between 1990 and 2019, by age, sex, and socio-demographic index (SDI).

Methods: Data on the prevalence, incidence, and years lived with disability (YLDs), due to gout, were obtained from the Global Burden of Disease study 2019 for the 21 countries in the MENA region, from 1990 to 2019.

Results: In 2019, the regional age-standardised point prevalence and annual incidence rates of gout were 509.1 and 97.7 per 100,000, which represent a 12.0% and an 11.1% increase since 1990, respectively. Moreover, in 2019 the regional age-standardised YLD rate was 15.8 per 100,000, an 11.7% increase since 1990. In 2019, Qatar and Afghanistan had the highest and lowest age-standardised YLD rates, respectively. Regionally, the age-standardised point prevalence of gout increased with age up to the oldest age group and it was more prevalent among males in all age groups. In addition, there was an overall positive association between SDI and the burden of gout between 1990 and 2019. In 2019, high body mass index (BMI) [46.1%] made the largest contributions to the burden of gout in the MENA region.

Conclusions: There were large inter-country variations in the burden of gout, but in general it has increased in MENA over the last three decades. This increase is in line with the global trends of gout. However, the age-standardised YLD rate change was higher in MENA than at the global level.

Key words: Gout; Prevalence; Incidence; YLD; Risk factor; Global Burden of Disease; Middle East and North Africa

Introduction

Gout is an inflammatory disease that occurs as a result of monosodium urate (MSU) crystal formation in the joints and other tissues, due to the super-saturation of uric acid in the blood.[1] The clinical manifestations of gout, such as swelling, warmth, redness, and pain in the affected joint, can result in sleep loss and problems working.[2] There are a number of genetic and environmental risk factors associated with gout, including medications, unhealthy diet, alcohol consumption, comorbidities, and exposure to lead.[3] These risk factors increase the level of uric acid in the blood and result in MSU crystal formation.[3] When hyperuricemia persists, approximately 10 years after the clinical onset of the disease, some patients develop tophus, which is the hallmark of chronic gout.[4,5] Apart from local symptoms, gout may also manifest itself with a range of renal, vascular, and articular complications.[6] These complications, alongside acute gout flare ups, impose a significant burden on the individual and the community as a whole.[7]

The GBD 2017 study on gout found that the global point prevalence, annual incidence and years lived with disability (YLDs) rate had increased by 7.2%, 5.5%, and 7.2% since 1990, respectively, with males accounting for a large portion of this burden.[8] In addition to the disabilities which result in a loss of health, gout also causes a substantial economic burden. The direct and indirect costs associated with gout have been estimated to range from nearly $4,000 to $18,000 USD per capita. The cost per affected individual depends on the serum uric acid level, frequency of attacks, and the presence of tophi.[9] Thus, alleviating the health and economic burden of gout may involve controlling the risk factors, preventing hyperuricemia, and appropriately managing acute episodes.

Any changes in the overall burden of gout may guide health policymakers' decisions in relation to the prevention and screening of gout, so providing up-to-date data on the burden of gout will help to improve the management of this disorder. Previous research has reported the global, regional, and national prevalence, as well as the incidence and YLDs attributable to gout from 1990 to 2017.[8] However, it is important to note that exposure to gout risk factors has changed substantially in recent years,[10] and the most recent research requires updating. Furthermore, there is a lack of information regarding the burden of gout, and its attributable risk factors, in the Middle East and North Africa (MENA) region. Providing detailed information at regional and country level would be beneficial for prevention and the implementation of interventions in those countries with larger burdens. Therefore, we aimed to report the point prevalence, annual incidence, and YLDs attributable to gout and its risk factors for the 21 countries located in the MENA region, from 1990 to 2019, by sex, age, and socio-demographic index (SDI).

Methods

The Global Burden of Disease (GBD) 2019 measures the burden of 369 diseases and injuries, from 1990 to 2019, for 204 countries and territories. The GBD project was established by the Institute of Health Metrics and Evaluation (IHME) and a detailed description of the methodology can be found in previous articles.[10-12] Furthermore, all GBD 2019 estimates are available using GBD Results (http://ghdx.healthdata.org/gbd-results-tool) and GBD Compare (https://vizhub.healthdata.org/gbd-compare/).

Case definition and data sources

The GBD study used the primary criteria developed by the American College of Rheumatology (ACR) in 1977, which includes the presence of MSU crystals in the joint fluid or the presence of a tophus proven to contain MSU crystals and at least six of 12 gout symptoms, or findings including more than one attack of acute arthritis, maximal inflammation development within a day, monoarticular arthritis attack, joint erythema, pain or swelling in the first metatarsophalangeal joint, unilateral attack of the first metatarsophalangeal or tarsal joints, suspected tophus, hyperuricemia, asymmetrical swelling within a joint on X-ray and negative culture of joint fluid for microorganisms during the joint inflammation attack.[11,13] The International Classification of Diseases (ICD) for gout are 274 (Version 9) and M10 (Version 10).

In GBD 2013, the following databases were searched from 1980-2009: MEDLINE, EMBASE, CINAHL, CAB Abstracts, and the WHO Library (WHOLIS).[11] Studies were excluded if they did not have representative samples, had small sample sizes (< 150 participant), were reviews or did not use a population-based approach. Finally, a detailed description of the information used to estimate the burden of gout is available from: https://ghdx.healthdata.org/gbd-2019/data-input-sources.[11]

Data processing and disease model

The prevalence estimates were stratified by sex and age. In cases where the prevalence rates were reported by sex using broad age groups (e.g., separate male and female prevalence rates for 20 to 65-year-olds) or by specific age groups, without separating the two sexes (e.g., 20 to 30 year olds and then 31 to 65 year olds, for both sexes), the age-specific estimates were separated by sex using the sex ratio reported by the study, taking into account the bounds of uncertainty. However, if the sex ratio was not available, a sex ratio was used from a meta-analysis of existing sex-specific data, using a Bayesian meta-regression, with a regularized and trimmed model (MR-BRT). The ratio of females to males was 0.33 (95% UI: 0.33 to 0.34). Bias adjustments were made to those studies which reported estimates across age groups of 25 years or more, and these were then separated into five-year age groups using the age pattern found in GBD 2017. Alternative case definitions were adjusted for using MR-BRT.[11]

DisMod-MR 2.1, a Bayesian meta-regression tool, was used to model the non-fatal burden of gout. Taking into consideration study and country level covariates, the point prevalence and annual incidence estimates were calculated by age, sex, location and year. It was assumed that there were zero cases of gout in those younger than 15 years of age and that excess mortality and the remission rates of gout did not exceed 0.01 and 0.2, respectively. The only change in the modeling strategy to that used in GBD 2017 was changing the coefficient of variation from 0.4 to

0.8 to improve the model fit to the data. The only country level covariate used was the summary exposure variable (SEV) scalar for gout, which summarises exposure to risks that were found in the GBD to increase the occurrence of gout (i.e., low glomerular filtration rate). The bounds ranged from 0.75 to 1.25, as the SEV is formed in such a way that the value should equal 1, if the risk estimates are accurate.

Severity and years lived with disability

Table S1 presents the three gout sequelae (asymptomatic, acute and polyarticular gout) and their associated disability weights (DWs). The severity distribution of gout was calculated using data from three studies about the number of attacks per year and a lognormal curve was fitted using the least squared differences approach.[14-16] There were no data available regarding chronic polyarticular gout, and so the proportion was taken to be the same as those who have at least 52 attacks a year (i.e., one or more each week), as estimated by the lognormal curve. The mean number of attacks was estimated to be 5.66 (5.14–6.18), also using a lognormal curve. The average duration of attacks was 6.1 (5.4–6.8) days, which was estimated using the results of two studies. The proportion of symptomatic time for acute gout was calculated to be 9.4% (8.0–10.9%), but multiplying the two estimates above and dividing this by 365 (days in a year).

Compilation of results

The years lived with disability (YLD) were estimated by multiplying the prevalence estimates for each sequela by their sequela-specific DWs. One YLD represents the equivalent of one full year of healthy life lost due to disability or ill-health, and YLD can be used to report the burden of a disease. DALY is a standard metric used to estimate the burden of disease and is calculated by summing the YLD and the years of life lost (YLL) due to premature deaths. As no mortality was attributable to gout, the YLD estimates were the same as the DALYs. The GBD standard population was used to standardise all estimates and 95% uncertainty intervals (UIs) were also included. Uncertainty was propagated by sampling 1000 draws at each step of the calculations. Final estimates were determined using the mean estimates across 1000 draws, and the 95% uncertainty intervals (UIs) were defined as the 25th and 975th values of the 1000 ordered draws.

Smoothing splines were used to investigate the relationship between the burden of gout and the socio-demographic index (SDI).[17] The SDI is comprised of the lag-distributed income per capita (smoothed over the previous 10 years), average years of schooling for those aged 15 and older, and the total fertility rate among women aged 25 and younger. The SDI ranges from 0 (lowest level of development) to 1 (highest level of development).[11] The point prevalence and annual incidence estimates were sourced from http://ghdx.healthdata.org/gbd-results-tool and presented using R software (Version 3.5.2).

Risk factors

The GBD study found strong evidence that gout was associated with high body mass index (BMI) and kidney dysfunction.[10] The population attributable fraction (PAF) was the proportional reduction in gout that would occur if exposure to each risk factor was lowered to the theoretical minimum risk exposure level (TMREL). The total number of YLDs due to gout that were attributable to each risk factor were calculated by multiplying the total YLD for gout and corresponding PAFs for each age group, sex, location, and year. The definition of high BMI and kidney dysfunction, along with detailed information on estimating the PAFs and their attributable burden, have been previously reported.[10]

Results

The Middle East and North Africa

The number of prevalent cases of gout in 2019 was 2.5 million (95% UI: 1.9 to 3), with an age-standardised point prevalence of 509.1 (406 to 633.9) per 100,000 population, which increased by 12% (10.1 to 13.9) between 1990 and 2019 (Table 1 and Table S1). In 2019, there were 490.3 thousand (389.9 to 606.8) incident cases of gout in the MENA region, with an age-standardised rate of 97.7 (78.5 to 123.2) per 100,000 population, an increase of 11.1% (9.2 to 12.9) since 1990 (Table 1 and Table S2). Gout also accounted for 77.5 thousand (48.8 to 111.7) regional YLDs in 2019. Furthermore, in 2019 the age-standardised YLD rate was 15.8 (10 to 22.7) per 100,000 population, an increase of 11.7% (7.1 to 16.4) since 1990 (Table 1 and Table S3).

National level

In 2019, the national age-standardised point prevalence of gout ranged from 427.8 to 734.8 cases per 100,000 population among the MENA countries. Qatar [734.8 (582.2 to 921.1)], the United Arab Emirates (UAE) [664.8 (525.4 to 831.2)] and Kuwait [612.2 (485.7 to 762.6)] had the three highest age-standardised point prevalence rates of gout in 2019. In contrast, Yemen [427.8 (340.5 to 534.9)], Afghanistan [437.9 (349.6 to 543.6)] and Palestine [475.3 (373.9 to 590.6)] had the three lowest rates (Figure 1A and Table S1).

The national age-standardised annual incidence rate of gout ranged from 84.1 to 137 cases per 100,000 population, with Qatar [137 (109.7 to 174.1)], the UAE [125.7 (100.7 to 157.9)] and Bahrain [115.4 (91.6 to 144.3)] having the highest rates. In contrast, Yemen [84.1 (67.4 to 104.8)], Afghanistan [85.9 (68.8 to 108.9)] and Palestine [91.5 (72.8 to 115.3)] had the lowest age-standardised annual incidence rates (Figure 1B and Table S2).

In 2019, the national age-standardised YLD rate of gout ranged from 13.2 to 22.5 cases per 100,000 population among the MENA countries. The three highest rates were found in Qatar [22.5 (14.5 to 32.7)], the UAE [20.5 (12.9 to 29.9)] and Kuwait [19 (11.7 to 27.6)]. Conversely, the countries with the lowest rates were Afghanistan [13.2 (8.3 to 19.2)], Yemen [13.3 (8.4 to 19.5)] and Palestine [14.6 (9.1 to 21.2)] (Figure 1C and Table S3).

The estimated percentage change in the age-standardised point prevalence and annual incidence rate, from 1990 to 2019, saw significant increases for most of the countries in the MENA region. Oman [27.1% (19.5 to 35.4)], the UAE [20.3 (11.8 to 29.5)] and Sudan [18.8 (11.7 to 25.7)] had the largest estimated increases in the age-standardised point prevalence over the measurement period (Table S1 and Figure S1). Furthermore, Oman [23.7 (16.4 to 32.3)], the UAE [18.1 (10.5 to 25.2)] and Qatar [16.7 (8.8 to 24.9)] showed the largest increases in the age-standardised annual incidence rate over the same period (Table S2 and Figure S2). Similarly, most MENA countries had substantial increases in the age-standardised YLD rates, with Oman [26.6 (9.6 to 46.2)], the UAE (19.6 (3 to 39.5) and Sudan [18.5 (2.7 to 34.6)] having the highest increases over the measurement period (Table S3 and Figure S3).

Age and sex patterns

In 2019, the regional point prevalence of gout was estimated to be highest in those aged 95^{+} years for both sexes. In addition, the number of prevalent cases peaked in the 55-59 and 60-64 age groups for males and females, respectively (Figure 2A). Similarly, in 2019 the regional annual incidence rate of gout was highest in the 95+ age group for both sexes. The number of incident cases reached its peak in those aged 50-54 and 55-59 years for both males and females, respectively (Figure 2B). Furthermore, a clear increase was observed in the regional YLD rates of gout for males and females up to the 95+ age group. Moreover, the number of YLDs were highest in the 50-54 and 55-59 age groups for males and females, respectively (Figure 2C). It is important to note that the regional point prevalence, annual incidence and YLD rates, together with the number of prevalent, incident, and YLD cases attributable to gout, were consistently higher for males across all ages.

The rate ratio of gout, comparing the age-standardised YLD rates in MENA to the global rates for the different age groups by sex in 1990 and 2019, revealed that the MENA region had lower age-standardised rates for males and females and in all age groups, except for females aged 40-44 in 2019 and females aged 45-59 in 1990, which were the same as the global average (Figure 3). In 2019, females aged 80 years or older and males aged 30-69 had the lowest rate ratios. Furthermore, in 1990 females aged 85 years or older and males aged 30-34 had the lowest age-standardised YLD rates, in comparison to the global average (Figure 3).

Association with socio-demographic index (SDI)

The burden of gout increased dramatically with rising socio-economic development, from 1990 to 2019. Several countries, such as Qatar, had much higher than expected burdens, while other countries, like Iran, Turkey, Yemen, and Morocco, had lower than expected burdens (Figure 4).

Risk factors

The proportion of YLDs due to gout, which were attributable to the individual risk factors, varied across the MENA countries. At the regional level, high body mass index (BMI) [46.1%] and kidney dysfunction [18.8%] were the two main contributors to the burden of gout in 2019. For males, the YLDs attributable to high BMI and kidney dysfunction were 46.3% and 17.9%, respectively, while for females these figures were 45.6% and 22.0%. The UAE had the largest burden of gout due to high BMI [61.9%], while Yemen had the lowest burden associated with high BMI [22.8%]. In terms of kidney dysfunction, Lebanon was estimated to have the highest attributable burden [25.1%], while the UAE the lowest burden [9.5%] (Figure 5).

Discussion

The present study used GBD 2019 data to report the levels and trends in the burden of gout and its attributable risk factors from 1990 to 2019 in the MENA region. The results showed increases in the point prevalence (12.0%), annual incidence (11.1%), and YLDs (11.7%) associated with gout over the period 1990 to 2019. The age-standardised burden of gout increased with advancing age and it was significantly higher among men. Furthermore, the burden of gout, as measured by the YLDs, was estimated to be positively associated with socio-economic status, and was lower than the global average in 1990 and 2019 among both sexes and in almost all age groups. In terms of risk factors, males had higher BMI attributable YLDs, while the attributable burden for kidney dysfunction was higher in females.

Previous studies, using GBD 2017 data, reported increases in the global point prevalence and annual incidence rate of gout over the period 1990 to 2017.[8] Also, a systematic review of epidemiological studies in 2015 showed that the MENA region had a prevalence of hyperuricemia between 8-12% which was lower than other regions like Oceania, East, and Southeast Asia,[18] which can be as a result of the fact that some populations have inherently higher or lower levels of serum urate levels that others regardless of their obesity status. Furthermore, there were geographic or ethnic differences reported in the occurrence of the disease across the world and differences in the modifiable and non-modifiable risk factors, such as alcohol consumption, high body mass index, and advancing age.[19] Trends in alcohol use, obesity, and aging in the general population might explain the increases found in the prevalence and incidence. The GBD 2019 risk factor study found that globally high BMI and alcohol consumption had both increased over the last three decades,[10] which could be partially responsible for the observed increases in the burden of gout during the same time period. Moreover, the contribution of high BMI to the overall age-standardised DALYs in MENA increased by 52.2% over the period 1990 to 2017.[20] These results are in accordance with our findings, which showed that 46.1% of the gout-attributable YLDs was due to high BMI in 2019. Furthermore, the age-standardised prevalence rate of chronic kidney disease increased by 1.9% in MENA between 1990 and 2017,[21] which may explain our finding that 18.8% of the YLDs were attributable to kidney dysfunction in 2019. Different strategies have been suggested for the prevention of chronic kidney disease, such as controlling blood pressure and blood glucose levels, lipid-lowering therapies, carefully controlling salt and protein intake, in addition to screening patients with certain comorbidities, in particular diabetes.[22] The most effective strategies for the prevention and control of excess body weight focus on two major areas, which are reducing unhealthy diets and increasing physical activity, by improving food systems/environment and making behavioral changes.[23]

In 2017, the global age-standardised prevalence and DALY rates of gout were 790.9 and 23.2 per 100,000 population in males, respectively, while these rates were 253.5 and 7.2 per 100,000 among females, respectively.[24] Furthermore, the global age-standardised prevalence and YLD rates, for both sexes combined, were 510.6 and 15.9 per 100,000 population in 2017.[8] In comparison, in 2019 the age-standardised prevalence and YLD rates in MENA (509.1 and 15.8 per 100,000, respectively) were almost the same as those observed in 2017 at the global level. However, the 2019 rates found in the present study were higher than the age-standardised prevalence and YLD rates found in 2017 (499.4 and 15.4 per 100,000, respectively).[8] The differences may be due to a slight increase in exposure to the important risk factors in recent years, as mentioned earlier.

Qatar had the highest age-standardised point prevalence in 2019, followed by the UAE and Kuwait. This is likely due to a higher prevalence of overweight and obesity in these countries. Furthermore, a study by Al-Thani and colleagues reported the prevalence of obesity and overweight in Qatar in 2015–2016 to be 44.8% in men and 40.4% in women, in those aged 5 to 19 years old.[25] According to the World Health Survey (WHS) 2006, the prevalence of obesity among the general population of Qatar was 32%, and 39% were overweight.[26] Another study by Sultan ALNohair reported that Qatar, Kuwait, and the UAE were among the countries with the highest prevalence of obesity in the region.[27] Having the highest age-standardised prevalence and incidence, it would be expected that the YLDs in Qatar would be high, which was supported by our data, as Qatar had the highest YLD in the MENA region. A study by Kelishadi et al. observed an association between diets high in carbohydrates and fat and obesity.[28] It has also been shown in multiple ethnicities that diets, together with physical activity level, affect the risk of obesity and eventually the risk of gout. With the expansion of the Western diet, fast food and fructose-rich beverages in those high SDI countries are likely contributing to higher BMI, serum uric acid, and the risk/prevalence of gout.[29] Therefore, the implementation of education and awareness campaigns, which aim to increase physical activity and provide nutritional guidance, are highly recommended to prevent obesity and its consequences, such as gout.[23]

Yemen and Afghanistan were among the countries with the lowest age-standardised point prevalence and annual incidence of gout in the MENA region. Interestingly, a previous study reporting the burden of obesity, using GBD 2015 data, showed a lower age-standardised point prevalence of obesity in Afghanistan and Yemen, compared with other MENA countries.[30] Therefore, the lower levels of obesity could be one of the reasons for the lower burden of gout in these countries. Further studies are needed to evaluate the effects of other potential risk factors, such as alcohol consumption, on the burden of gout in the MENA region.

The present study found that 46.1% of gout YLDs were attributable to high BMI. A pathophysiological mechanism for the effects of free fatty acid on the development of gout has previously been suggested. The stimulation of toll-like receptors and the initiation of inflammatory cascades, due to the synergism between MSU crystals and free fatty acids, have been proposed to explain the effects of obesity on gout occurrence.[31]

Consistent with the global findings, in MENA the prevalence of gout was higher among males than among females.[8] Similarly, the global age-standardised prevalence rate of gout in 2017 increased with advancing age, but the observed increase was higher in MENA than was the global increase.[8] These findings might be due to higher serum uric acid levels in men than in women before menopause, which might be due to higher estrogen levels in women before menopause.[32] Although in 2017 the global point prevalence of musculoskeletal disorders (i.e. low back pain, neck pain, osteoarthritis, rheumatoid arthritis, gout, and other musculoskeletal disorders) was higher in females than males, the disorders all increased with age up to the oldest age group.[33] The differences in the sex patterns between gout and other musculoskeletal disorders could be as a result of different pathophysiologies, underlying mechanisms, and risk factors which contribute to the development of these disorders.[33,34] Furthermore, the percentage change in the age-standardised prevalence per 100,000 population was higher in females over the period 1990-2019, but further research is needed to determine the underlying reason for this.

The current study showed that the age-standardised YLD rate increased with increasing SDI in the MENA region. This finding is also in accordance with the global trend reported in 2017, which showed a positive association between SDI and the gout-related age-standardised YLD rate.[8] Furthermore, the age-standardised DALYs attributable to musculoskeletal disorders were also positively related to SDI at the global and regional levels in 2017.[33] Therefore, preventative programs are needed for the middle-aged people identification and treatment of gout, particularly in countries with a high socioeconomic status.

Strengths and Limitation of the study

This is the first study to use data from GBD 2019 to evaluate the burden of gout and its attributable risk factors in the MENA region. However, we acknowledge that our study has several limitations. The main limitation of the study is data sparsity on the incidence and prevalence of gout in several of the MENA countries, especially the less developed countries which might not keep precise records or have registries for gout. As mentioned previously, studies have indicated several risk factors which play a role in the incidence of gout, including race, lifestyle, gender, high BMI, alcohol consumption, genetic variations and increased serum uric acid levels, which might be due to renal dysfunction or increased uric acid production. However, we only investigated high BMI and kidney dysfunction as risk factors for gout, as the data regarding the other risk factors were not included in the GBD study. Thus, a more comprehensive study is required to investigate other risk factors, which should be undertaken in the next GBD iteration. Moreover, there is some disparity in the female data, when compared to the 2017 global burden of gout,[24] which may indicate an under diagnosis of gout among females in the MENA region. Therefore, at least the same focus should be given to women, preferably even more, given the lack of data about gout among women in the region. Due to the differences in the burden of gout in urban and rural areas, health policy programs should be designed for the area in which they operate. However, we did not have the data to compare different subnational regions, nor to investigate the prevalence among different ethnicities within each country.

Conclusions

The point prevalence, annual incidence and YLD rates attributable to gout increased from 1990 to 2019 in the MENA region, and there were substantial differences between countries. This increase is in line with the global trends for gout, with the global burden also increasing over the period 1990 to 2017. However, the increase in the age-standardised YLD rate was higher in MENA than it was at the global level. Furthermore, high BMI was one of the largest contributors to the regional burden of gout, which needs to be targeted with policy interventions to encourage people to adopt healthier lifestyles. Interventions to control gout should particularly target middle-aged individuals and those living in countries with a higher socioeconomic status.

Declarations

Contributors

SS, AK and AAK designed the study and analysed the data and performed the statistical analyses. FA, SAN, MN, MJMS, JSK, GSC, AAK and SS drafted the initial manuscript. All authors reviewed the drafted manuscript for critical content. All authors approved the final version of the manuscript.

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Competing interests

None declared.

Ethics approval

The present study was approved by Ethics Committee of Tabriz University of Medical Sciences, Tabriz, Iran (IR.TBZMED.REC.1400.1168).

Patient consent for publication

Not required.

Patient and public involvement

Patients and the public were not involved in the analyses or preparation of this manuscript.

Data sharing statement

The data used for these analyses are all publicly available.

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Author note

This study is based on publicly available data and solely reflects the opinion of its authors and not that of the Institute for Health Metrics and Evaluation.

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Table and figure legends

Table 1: Prevalent cases, incident cases and YLDs due to gout in 2019, and the percentage change in the age-standardised rates during the period 1990-2019. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Figure 1: Age-standardised point prevalence (A), incidence (B), and YLDs (C) of gout (per 100,000 population) in the Middle East and North Africa region in 2019, by sex and country. YLD= years lived with disability. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Figure 2: Numbers of prevalent cases and prevalence (A), number of incident cases and incidence rate (B) and the number of YLDs and YLD rate (C) for gout per 100,000 population in the Middle East and North Africa region, by age and sex in 2019; Dotted and dashed lines indicate 95% upper and lower uncertainty intervals, respectively. YLD= years lived with disability. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Figure 3: Ratio of the Middle East and North Africa region to the global gout YLD rate according to age group and sex, 1990–2019. YLD= years lived with disability. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Figure 4: Age-standardised YLD rates of gout for 21 countries and territories, by SDI in 2019; Expected values based on the Socio-demographic Index and disease rates in all locations are shown as the black line. Each point shows the observed age-standardised YLD rate for each country in 2019. YLD= years lived with disability. SDI= Socio-demographic Index. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Figure 5: Percentage of YLDs due to gout attributable to risk factors for the Middle East and North Africa countries in 2019. YLD= years lived with disability. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Table S1: Prevalence of gout in 1990 and 2019 for both sexes and the percentage change in the age-standardised rates (ASRs) per 100,000 in the North Africa and the Middle East region (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Table S2: Incidence of gout in 1990 and 2019 for both sexes and the percentage change in the age-standardised rates (ASRs) per 100,000 in the North Africa and the Middle East region (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Table S3: YLDs due to gout in 1990 and 2019 for both sexes and the percentage change in the age-standardised rates (ASRs) per 100,000 in the North Africa and the Middle East region (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Figure S1: The percentage change in the age-standardised point prevalence of gout in the Middle East and North Africa region from 1990 to 2019, by sex and country. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Figure S2: The percentage change in the age-standardised incidence of gout in the Middle East and North Africa region from 1990 to 2019, by sex and country. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

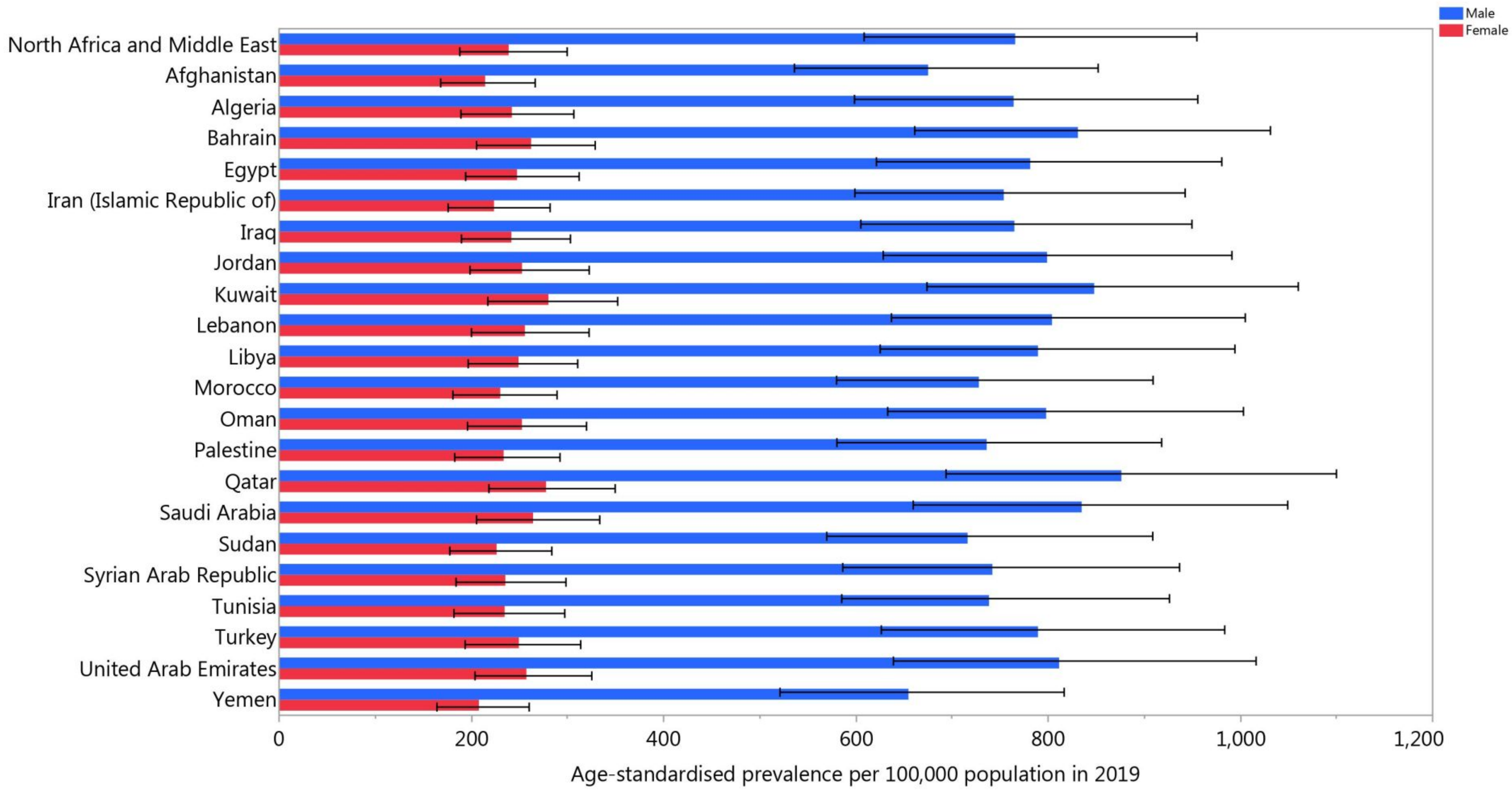
Figure S3: The percentage change in the age-standardised YLDs of gout in the Middle East and North Africa region from 1990 to 2019, by sex and country. YLD= years lived with disability. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

Table 1: Prevalent cases, incident cases and YLDs due to gout in 2019 and the percentage change in the age-standardized rates during 1990-2019

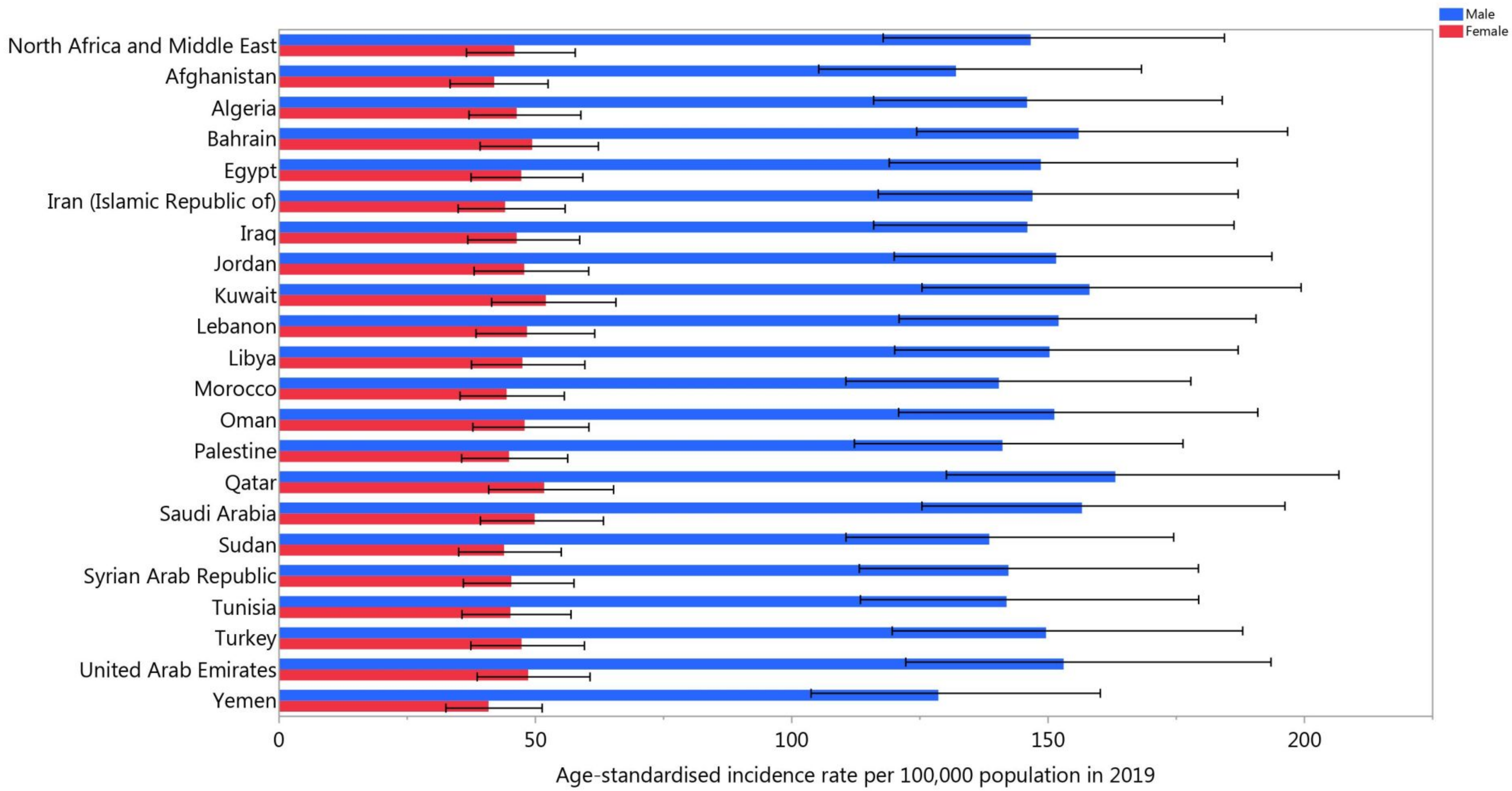
	Prevalence (95% UI)			Incidence (95% UI)			YLDs (95% UI)		
	Counts (2019)	ASRs per 100,000 (2019)	Pcs in ASRs 1990-2019	Counts (2019)	ASRs per 100,000 (2019)	Pcs in ASRs 1990-2019	Counts (2019)	ASRs per 100,000 (2019)	Pcs in ASRs 1990-2019
North Africa and Middle East	2455601 (1940521 , 3045022)	509.1 (406 , 633.9)	12 (10.1 , 13.9)	490264 (389868 , 606813)	97.7 (78.5 , 123.2)	11.1 (9.2 , 12.9)	77514 (48808 , 111730)	15.8 (10 , 22.7)	11.7 (7.1 , 16.4)
Afghanistan	67747 (53802 , 84327)	437.9 (349.6 , 543.6)	9.1 (2.6 , 15.8)	14470 (11369 , 18333)	85.9 (68.8 , 108.9)	9 (2.5 , 16.2)	2113 (1314 , 3066)	13.2 (8.3 , 19.2)	8 (-5.9 , 23.4)
Algeria	184417 (145466 , 232406)	509.1 (399.3 , 637.9)	15.2 (8.3 , 22.4)	36290 (28880 , 45641)	97.2 (77.3 , 122.6)	13.5 (6.8 , 19.7)	5822 (3632 , 8416)	15.9 (9.9 , 23)	14.9 (1.3 , 32)
Bahrain	9085 (7019 , 11495)	611.5 (485.4 , 762.1)	14.3 (7.1 , 22.1)	1818 (1376 , 2311)	115.4 (91.6 , 144.3)	13.1 (6.6 , 20.3)	291 (180 , 434)	18.9 (12 , 27.5)	13.9 (-0.7 , 30.5)
Egypt	374416 (293642 , 470254)	540.5 (430.3 , 674.5)	16.7 (10.4 , 23.5)	74402 (59281 , 92868)	102.4 (82.2 , 128.5)	14.8 (8.8 , 21.5)	11900 (7337 , 17404)	16.9 (10.5 , 24.4)	16.3 (1.8 , 32.9)
Iran (Islamic Republic of)	390085 (307601 , 486535)	489.3 (388.1 , 616.9)	7.5 (5.4 , 9.3)	78473 (61932 , 98315)	95.7 (76.2 , 121.4)	7.2 (5.4 , 9)	12230 (7692 , 17716)	15.2 (9.5 , 22)	7.5 (3.9 , 11.5)
Iraq	132187 (103630 , 163705)	498.8 (395.2 , 619.9)	1.9 (-3.9 , 8.1)	26852 (21041 , 33650)	95.6 (76 , 121.1)	2.8 (-2.8 , 8.7)	4159 (2661 , 5969)	15.4 (10 , 22.2)	2.5 (-10.5 , 17.2)
Jordan	42332 (33155 , 52869)	543.6 (429.6 , 678.2)	14.2 (7.7 , 20.9)	8503 (6621 , 10761)	103.3 (82.4 , 131.3)	13 (6.4 , 19.2)	1353 (837 , 1980)	17 (10.5 , 24.5)	14.2 (0.3 , 30.1)
Kuwait	22340 (17580 , 28038)	612.2 (485.7 , 762.6)	6.5 (-0.5 , 15.2)	4469 (3420 , 5600)	113.5 (90 , 143.2)	4.7 (-1.6 , 12)	714 (432 , 1055)	19 (11.7 , 27.6)	5.2 (-7 , 20.7)
Lebanon	26596 (21125 , 33162)	504.8 (400.9 , 633.2)	9 (2.6 , 15.6)	5069 (4058 , 6345)	95.7 (76.5 , 120.5)	7.7 (1.8 , 14)	821 (516 , 1182)	15.5 (9.8 , 22.5)	8.1 (-5 , 24.1)

Libya	31013 (24447 , 38517)	525.6 (418.7 , 659.2)	3.8 (-2.1 , 9.9)	6174 (4849 , 7672)	100.1 (80.1 , 124.9)	3.8 (-2.1 , 9.9)	973 (598 , 1433)	16.2 (10 , 23.8)	2.3 (-10.2 , 16.5)
Morocco	157478 (125035 , 198113)	476.3 (381.3 , 597.3)	11.7 (6.3 , 18.3)	31153 (24450 , 39270)	92 (73 , 116.2)	10.8 (4.3 , 16.7)	4964 (3100 , 7149)	14.8 (9.2 , 21.5)	10.9 (-3 , 26.7)
Oman	16883 (13104 , 21241)	574.8 (454.3 , 723.6)	27.1 (19.5 , 35.4)	3651 (2782 , 4600)	110.2 (87.7 , 138.6)	23.7 (16.4 , 32.3)	547 (338 , 798)	17.9 (11.2 , 25.7)	26.6 (9.6 , 46.2)
Palestine	13342 (10565 , 16661)	475.3 (373.9 , 590.6)	8 (1.6 , 14.9)	2729 (2135 , 3400)	91.5 (72.8 , 115.3)	7.9 (2 , 13.8)	419 (260 , 603)	14.6 (9.1 , 21.2)	7.3 (-6 , 22.6)
Qatar	14251 (10929 , 18189)	734.8 (582.2 , 921.1)	18.1 (10 , 27.2)	3048 (2311 , 3873)	137 (109.7 , 174.1)	16.7 (8.8 , 24.9)	461 (283 , 683)	22.5 (14.5 , 32.7)	16.4 (0.9 , 34.5)
Saudi Arabia	157065 (122656 , 199612)	607.8 (483 , 760.2)	18.3 (11 , 25.4)	32533 (24732 , 40855)	114.2 (91.4 , 143.5)	15.8 (9.7 , 22.8)	4996 (3196 , 7188)	18.6 (11.8 , 26.7)	17.5 (2.8 , 35.1)
Sudan	103804 (81093 , 129860)	486.4 (383.9 , 615.4)	18.8 (11.7 , 25.7)	21297 (16849 , 26431)	93.8 (74.8 , 119.4)	16.6 (9.7 , 23.3)	3288 (2104 , 4821)	15.1 (9.6 , 22)	18.5 (2.7 , 34.6)
Syrian Arab Republic	63962 (50266 , 81403)	493.5 (393.2 , 623.2)	6 (0.3 , 12.1)	12440 (9830 , 15832)	94.1 (75 , 119.2)	5 (-0.7 , 10.6)	2003 (1243 , 2926)	15.3 (9.7 , 22.3)	4.5 (-8.9 , 19.7)
Tunisia	61954 (48867 , 78282)	479.3 (380.9 , 602.7)	7.8 (1.8 , 15)	11997 (9508 , 15219)	92.2 (73.4 , 116.6)	7.4 (2.2 , 13.1)	1936 (1196 , 2795)	14.9 (9.2 , 21.5)	7.3 (-6.2 , 23.6)
Turkey	462176 (364077 , 573854)	507.8 (400.6 , 634.6)	9.5 (3.6 , 15.2)	88711 (70737 , 111000)	96.6 (77.2 , 121.7)	8.5 (3 , 14.4)	14525 (9000 , 21308)	15.9 (9.9 , 23.3)	9.4 (-4 , 25.7)
United Arab Emirates	54993 (40988 , 71980)	664.8 (525.4 , 831.2)	20.3 (11.8 , 29.5)	11590 (8466 , 15033)	125.7 (100.7 , 157.9)	18.1 (10.5 , 25.2)	1788 (1077 , 2712)	20.5 (12.9 , 29.9)	19.6 (3 , 39.5)
Yemen	66982 (53318 , 82420)	427.8 (340.5 , 534.9)	12.6 (5.7 , 19.8)	14099 (11239 , 17368)	84.1 (67.4 , 104.8)	11.5 (5.2 , 17.8)	2133 (1349 , 3134)	13.3 (8.4 , 19.5)	12.4 (-2.2 , 29)

A)

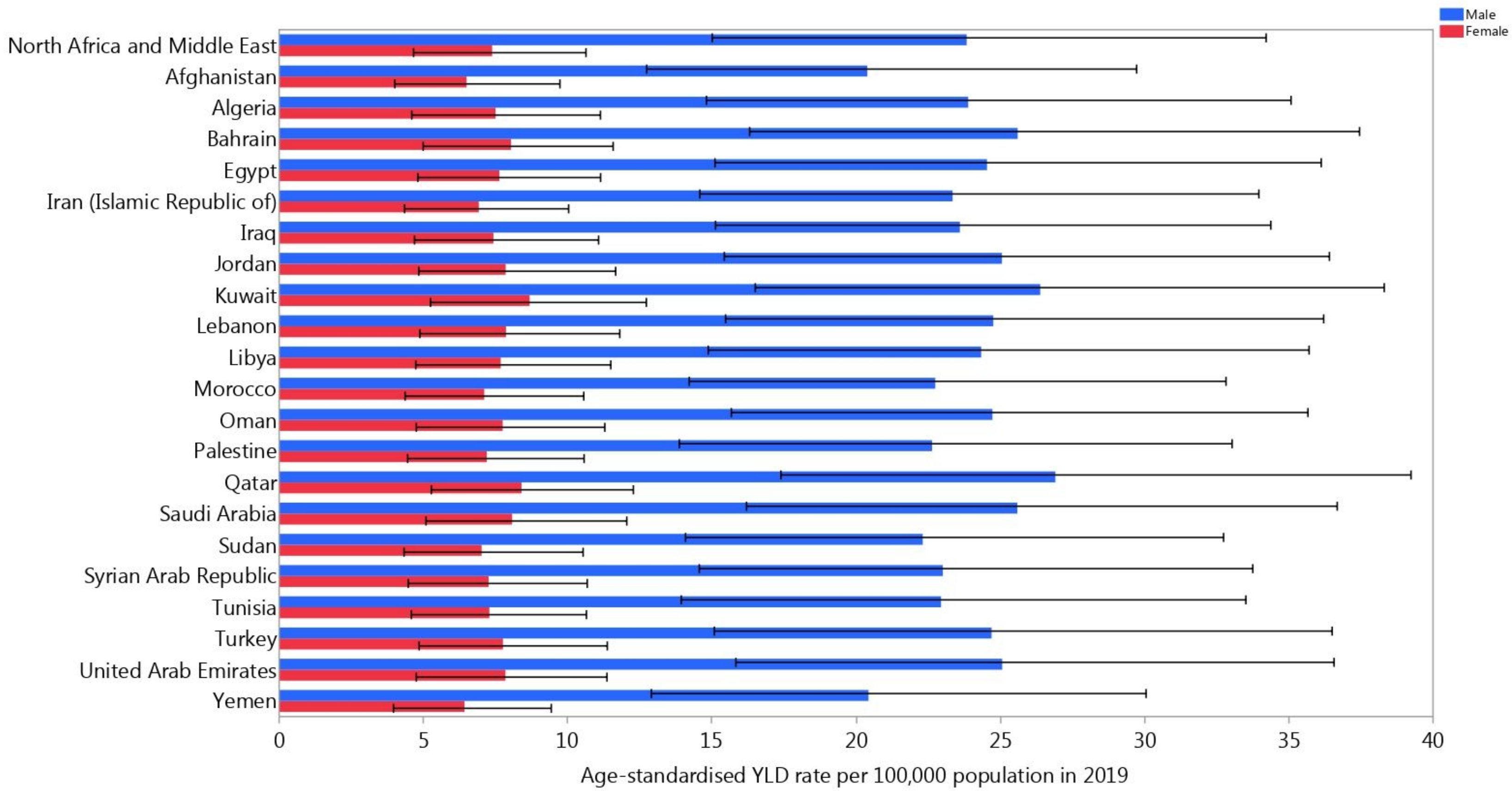

Male
Female
North Africa and Middle East
Afghanistan
Algeria
Bahrain
Egypt
Iran (Islamic Republic of)
Iraq
Jordan
Kuwait
Lebanon
Libya
Morocco
Oman
Palestine
Qatar
Saudi Arabia
Sudan
Syrian Arab Republic
Tunisia
Turkey
United Arab Emirates
Yemen
0
200
400
600
800
1,000
1,200
Age-standardised prevalence per 100,000 population in 2019

B)



Male
Female
North Africa and Middle East
Afghanistan
Algeria
Bahrain
Egypt
Iran (Islamic Republic of)
Iraq
Jordan
Kuwait
Lebanon
Libya
Morocco
Oman
Palestine
Qatar
Saudi Arabia
Sudan
Syrian Arab Republic
Tunisia
Turkey
United Arab Emirates
Yemen
0
50
100
150
200
Age-standardised incidence rate per 100,000 population in 2019

C)


Male
Female
North Africa and Middle East
Afghanistan
Algeria
Bahrain
Egypt
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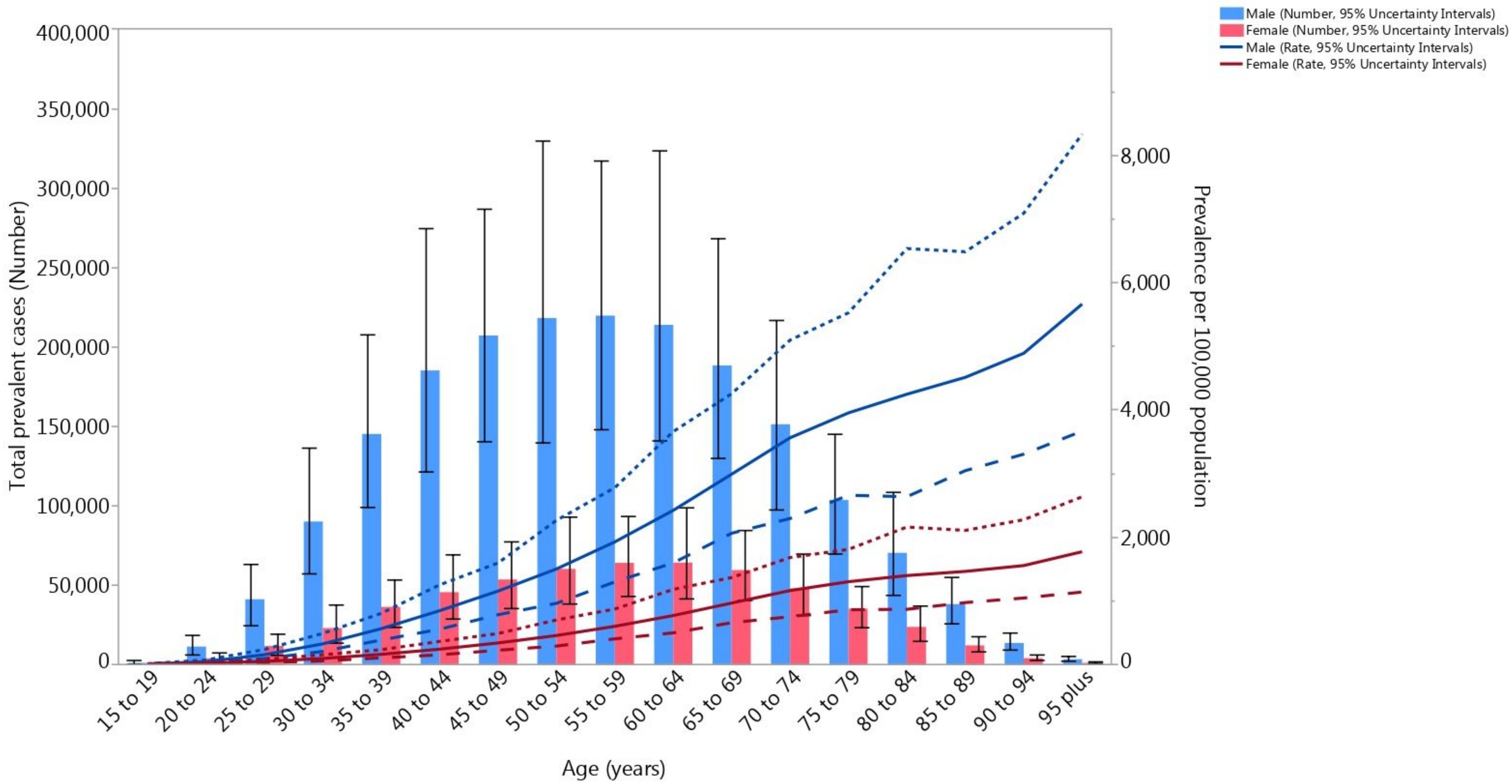
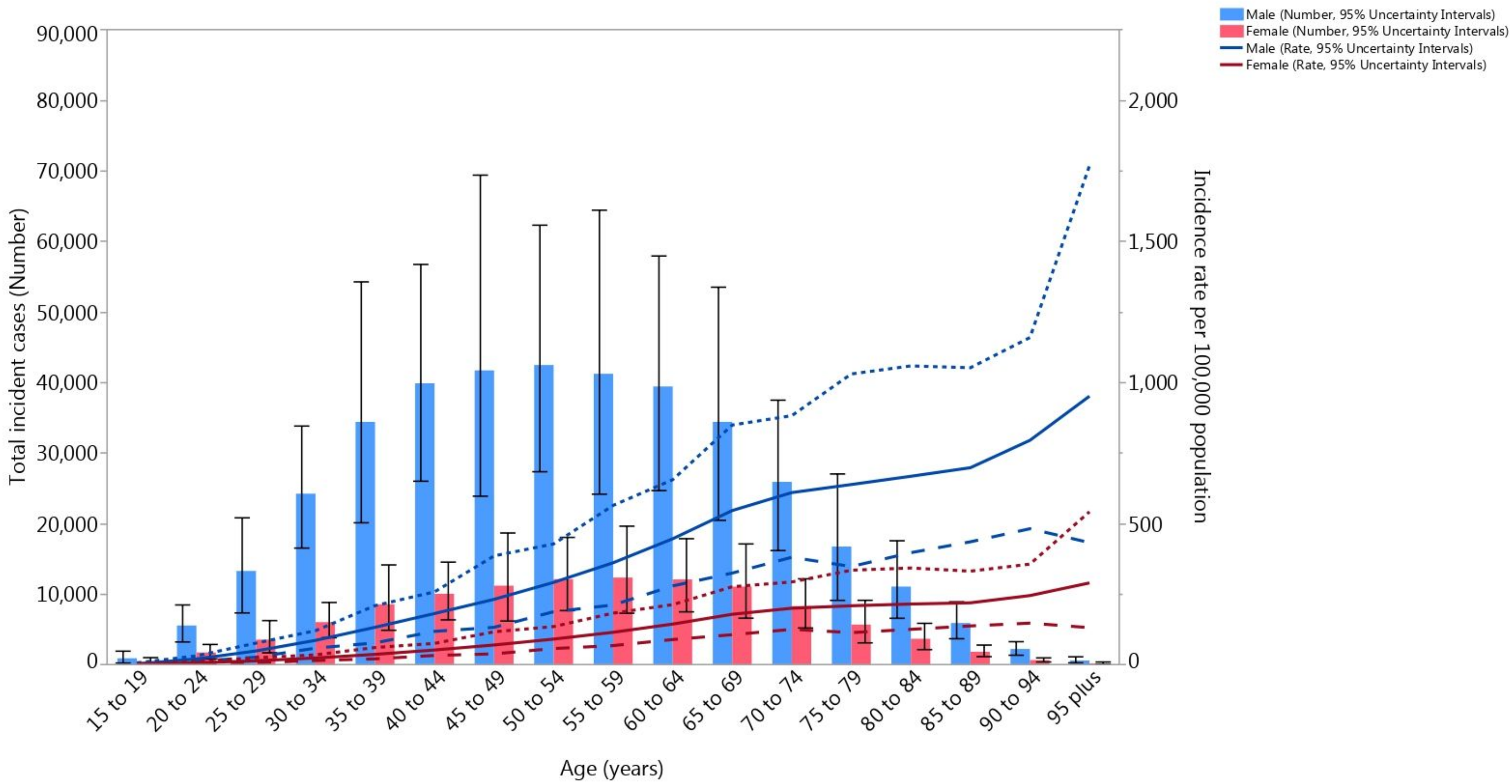
Iraq
Jordan
Kuwait
Lebanon
Libya
Morocco
Oman
Palestine
Qatar
Saudi Arabia
Sudan
Syrian Arab Republic
Tunisia
Turkey
United Arab Emirates
Yemen
0
5
10
15
20
25
30
35
40
Age-standardised YLD rate per 100,000 population in 2019

Figure 1: Age-standardised point prevalence (A), incidence (B), and YLDs (C) of gout (per 100,000 population) in the Middle East and North Africa region in 2019, by sex and country. YLD= years lived with disability. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

A)


Male (Number, 95% Uncertainty Intervals)
Female (Number, 95% Uncertainty Intervals)
Male (Rate, 95% Uncertainty Intervals)
Female (Rate, 95% Uncertainty Intervals)
Total prevalent cases (Number)
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Prevalence per 100,000 population
8,000
6,000
4,000
2,000
0
15 to 19
20 to 24
25 to 29
30 to 34
35 to 39
40 to 44
45 to 49
50 to 54
55 to 59
60 to 64
65 to 69
70 to 74
75 to 79
80 to 84
85 to 89
90 to 94
95 plus
Age (years)

B)


Male (Number, 95% Uncertainty Intervals)
Female (Number, 95% Uncertainty Intervals)
Male (Rate, 95% Uncertainty Intervals)
Female (Rate, 95% Uncertainty Intervals)
Total incident cases (Number)
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Incidence rate per 100,000 population
2,000
1,500
1,000
500
0
15 to 19
20 to 24
25 to 29
30 to 34
35 to 39
40 to 44
45 to 49
50 to 54
55 to 59
60 to 64
65 to 69
70 to 74
75 to 79
80 to 84
85 to 89
90 to 94
95 plus
Age (years)

C)

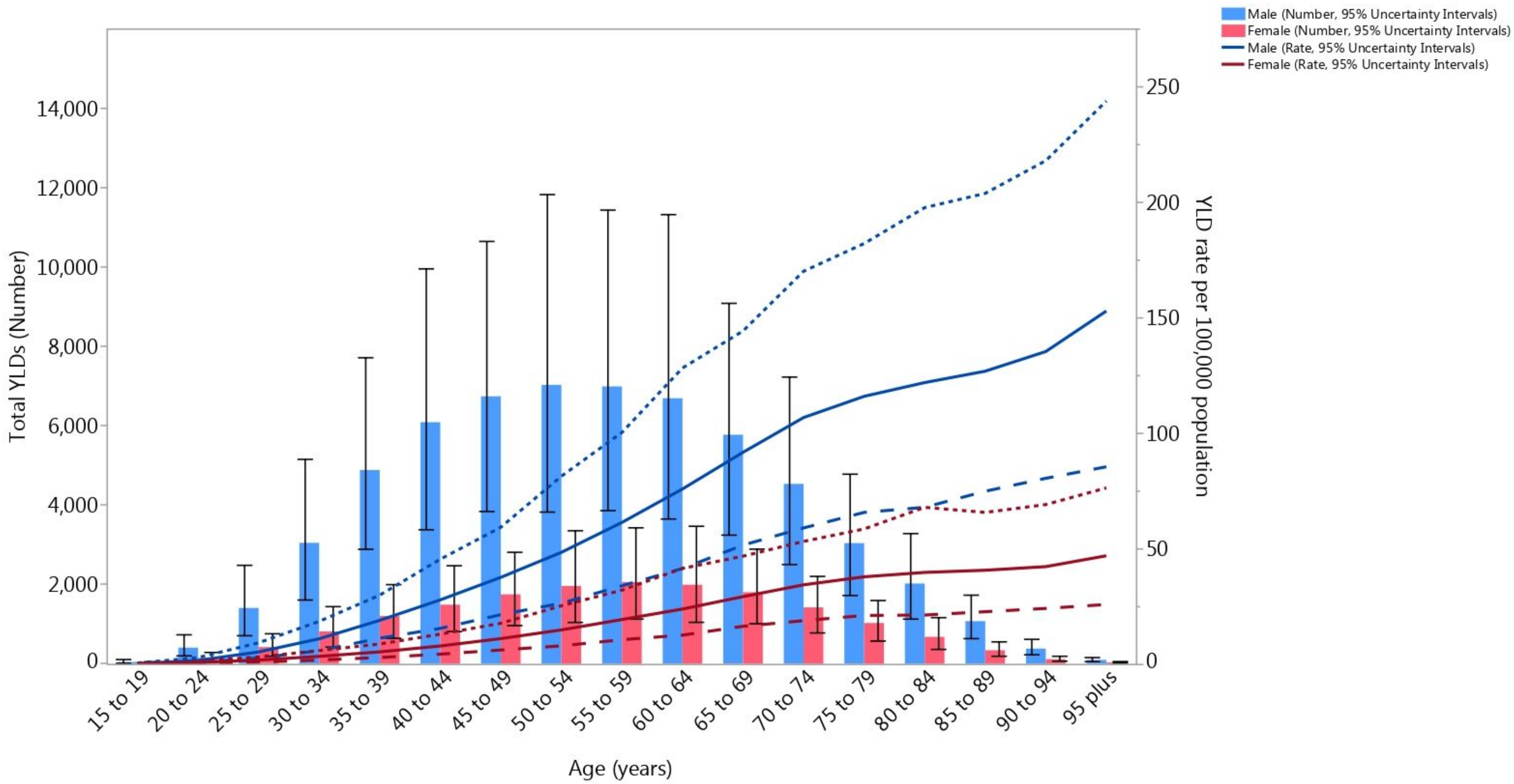


Figure 2: Numbers of prevalent cases and prevalence (A), number of incident cases and incidence rate (B) and the number of YLDs and YLD rate (C) for gout per 100,000 population in the Middle East and North Africa region, by age and sex in 2019; Dotted and dashed lines indicate 95% upper and lower uncertainty intervals, respectively. YLD= years lived with disability. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

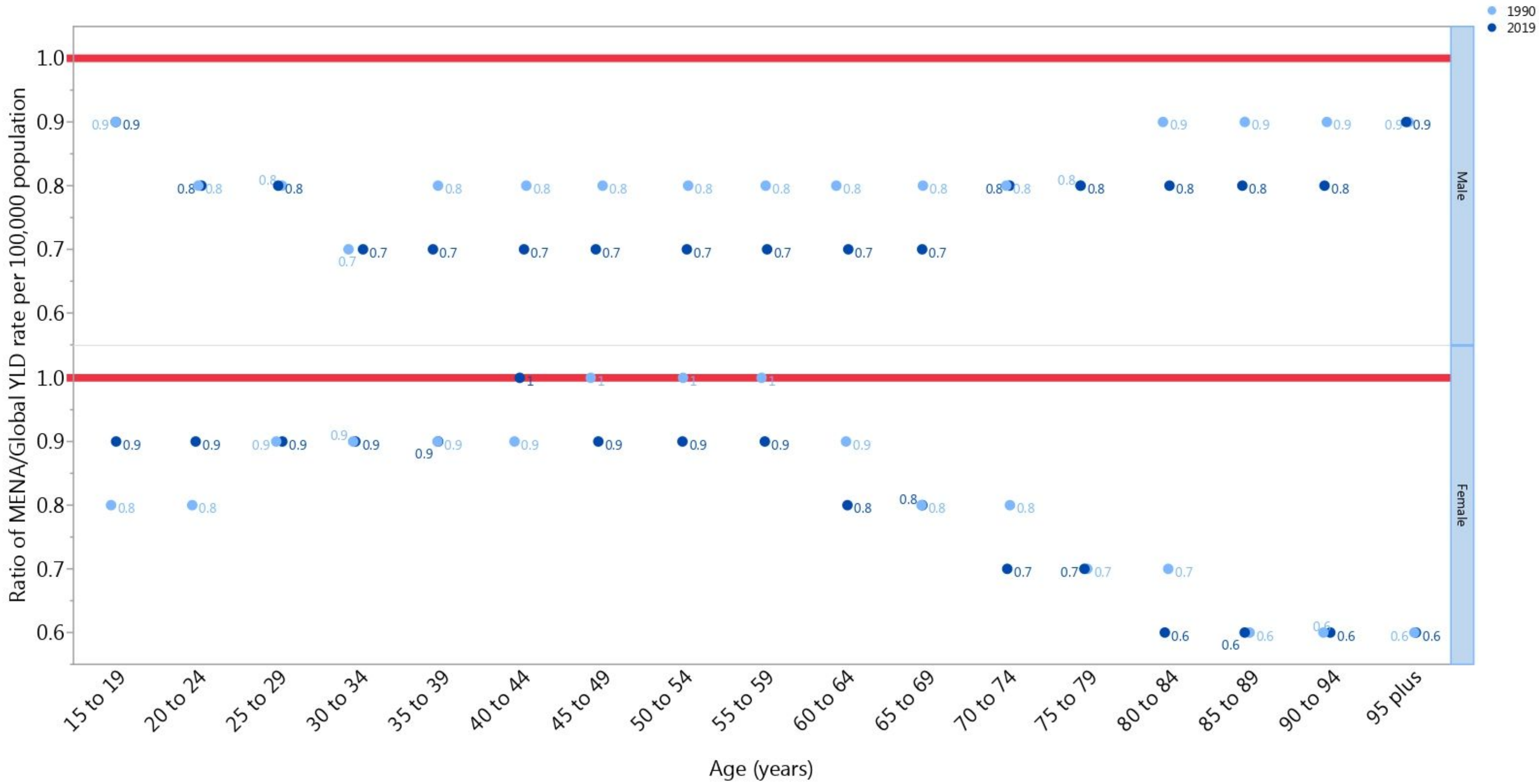


Figure 3: Ratio of the Middle East and North Africa region to the global gout YLD rate according to age group and sex, 1990–2019.

YLD= years lived with disability. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

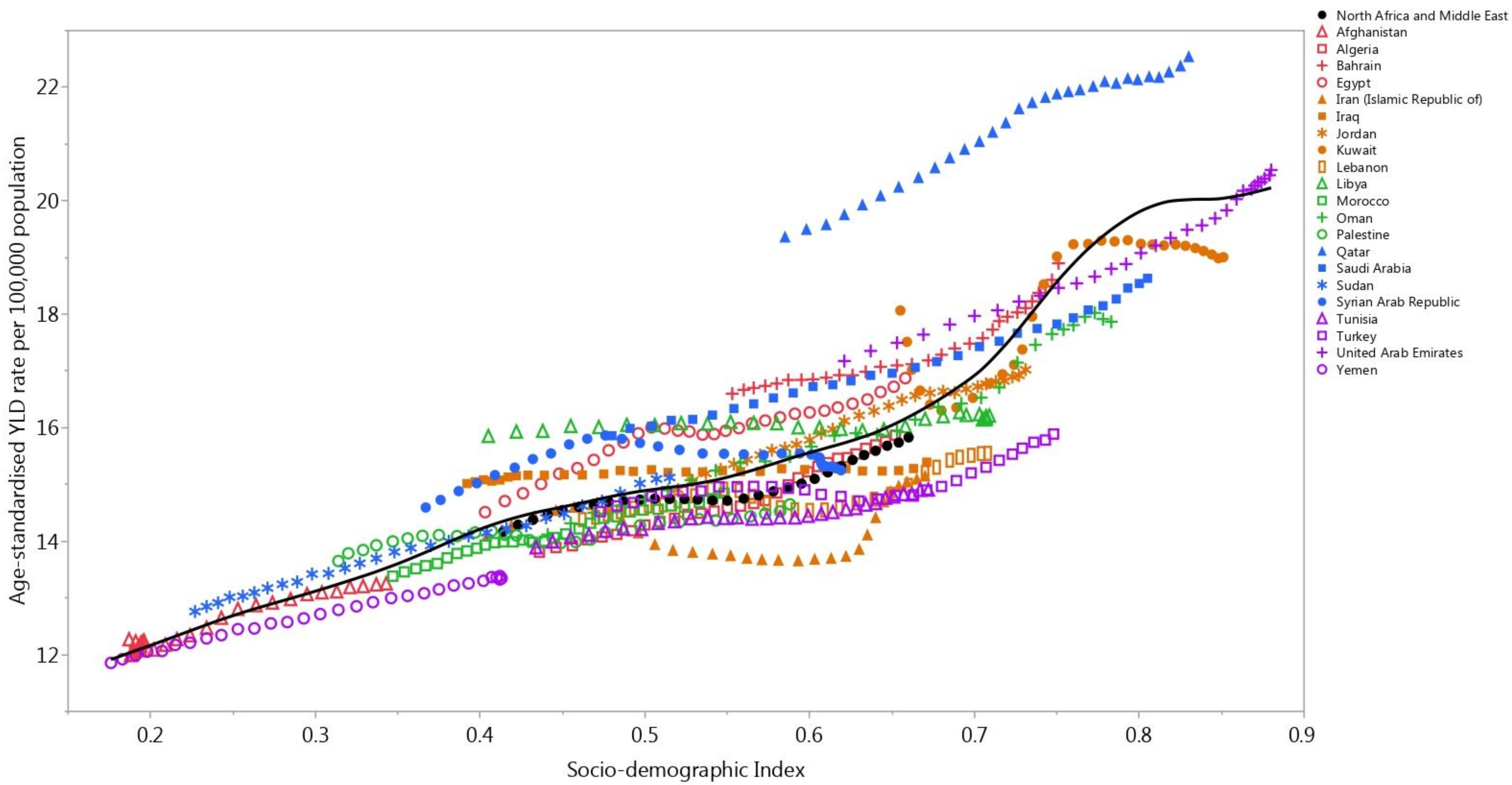


Figure 4: Age-standardised YLD rates of gout for 21 countries and territories, by SDI in 2019; Expected values based on the Socio-demographic Index and disease rates in all locations are shown as the black line. Each point shows the observed age-standardised YLD rate for each country in 2019. YLD= years lived with disability. SDI= Socio-demographic Index. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).

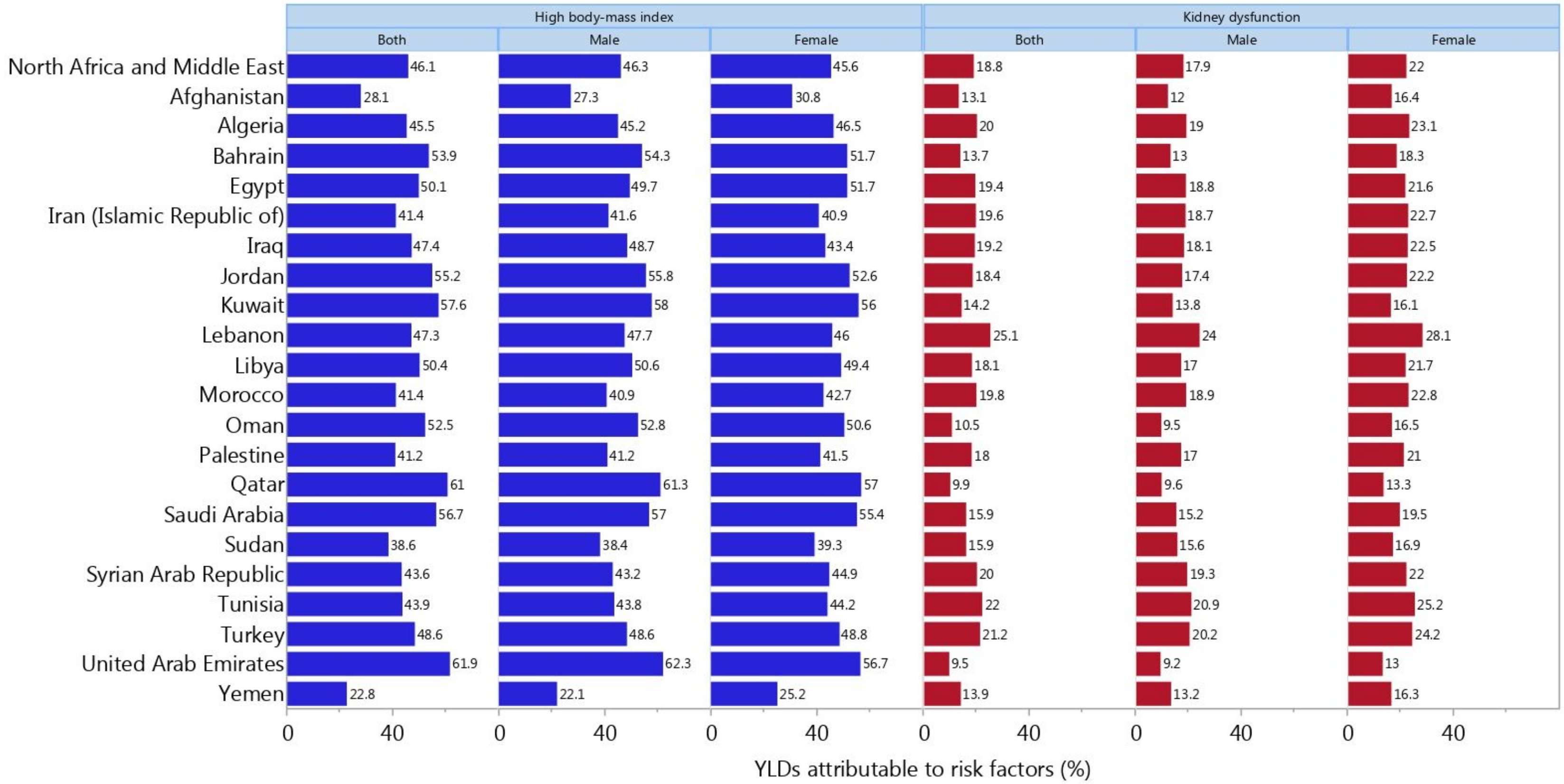


Figure 5: Percentage of YLDs due to gout attributable to risk factors for the Middle East and North Africa countries in 2019. YLD= years lived with disability. (Generated from data available from http://ghdx.healthdata.org/gbd-results-tool).