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The Burden of Gout and Its Attributable Risk Factors in the Middle East and North Africa Region, 1990 to 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 sociodemographic index (SDI).

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

Results. In 2019, the regional age-standardized point prevalence and annual incidence rates of gout were 509.1 and 97.7 per 100,000 population, which represent a 12% and 11.1% increase since 1990, respectively. Moreover, in 2019 the regional age-standardized YLD rate was 15.8 per 100,000 population, an 11.7% increase since 1990. In 2019, Qatar and Afghanistan had the highest and lowest age-standardized YLD rates, respectively. Regionally, the age-standardized 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 BMI (46.1%) was the largest contributor to the burden of gout in the MENA region.

Conclusion. There were large intercountry variations in the burden of gout, but in general, it has increased in MENA over the last 3 decades. This increase is in line with the global trends of gout. However, the age-standardized YLD rate change was higher in MENA than at the global level.

Key Indexing Terms: global burden of disease, gout, incidence, Middle East and North Africa, prevalence, risk factor, years lived with disability

Gout is an inflammatory disease that occurs as a result of monosodium urate (MSU) crystal formation in the joints and other tissues because of the supersaturation 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 deprivation and work interference.[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 flares, impose a significant burden on the individual and the community as a whole.[7]

The Global Burden of Disease (GBD) 2017 study on gout found that the global point prevalence, annual incidence, and years lived with disability (YLD) rates had increased by 7.2%,

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5.5%, and 7.2%, respectively, since 1990, 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 $4000 to $18,000 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; thus, 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 YLD rates attributable to gout from 1990 to 2017.[8] However, it is important to note that exposure to gout risk factors have changed substantially in recent years,[10] and the most recent research requires updating. Further, 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 levels 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 YLD rates attributable to gout and its risk factors for the 21 countries located in the MENA region from 1990 to 2019 by sex, age, and sociodemographic index (SDI).

METHODS

The 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; a detailed description of the methodology can be found in previous articles.[10-12] Further, all GBD 2019 estimates are available using GBD Results (https://vizhub.healthdata.org/gbd-results/) 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 in 1977. The criteria include the presence of MSU crystals in the joint fluid or the presence of a tophus proven to contain MSU crystals and at least 6 of 12 gout symptoms, or findings including the following: > 1 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 radiographs, and negative culture of joint fluid for microorganisms during the joint inflammation attack.[11,13] The International Classification of Diseases for gout are 274 (9th revision) and M10 (10th revision).

In GBD 2013, the following databases were searched from 1980 to 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 participants), 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 the GBD 2019 Data Input Sources Tool (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 (eg, separate male and female prevalence rates for age 20-65 yrs) or by specific age groups, without separating the 2 sexes (eg, age 20-30 yrs and then 31-65 yrs, 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 metaanalysis of existing sex-specific data, using a Bayesian metaregression, with a regularized and trimmed model (MR-BRT). The ratio of females to males was 0.33 (95% uncertainty interval [UI] 0.33-0.34). Bias adjustments were made to those studies that reported estimates across age groups of ≥ 25 years, and these were then separated into 5-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 (https://pypi.org/project/dismod-mr/), a Bayesian metaregression tool, was used to model the nonfatal 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 0 cases of gout in those aged < 15 years 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 summarizes exposure to risks that were found in the GBD to increase the occurrence of gout (ie, 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 YLD. Supplementary Table S1 (available with the online version of this article) presents the 3 gout sequelae (asymptomatic, acute, and polyarticular gout) and their associated disability weights (DWs). The severity distribution of gout was calculated using data from 3 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 (ie, ≥ 1 each week), as estimated by the lognormal curve. The mean number of attacks was estimated to be 5.66 (95% UI 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 2 studies. The proportion of symptomatic time for acute gout was calculated to be 9.4% (8.0-10.9) by multiplying the 2 estimates above and dividing this by 365 (days in a year).

Compilation of results. The YLD were estimated by multiplying the prevalence estimates for each sequela by their sequela-specific DWs. One YLD represents the equivalent of 1 full year of healthy life lost as a result of disability or ill health. YLD can be used to report the burden of a disease. Daily-adjusted life-years (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 due to premature deaths. As no mortality was attributable to gout, the YLD estimates were the same as the DALY. The GBD standard population was used to standardize all estimates and 95% 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% 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 SDI.[17] The SDI comprises the lag-distributed income per capita (smoothed over the previous 10 yrs), average years of schooling for those aged ≥ 15 years, and the total fertility rate among women aged ≤ 25 years. 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 https://vizhub.healthdata.org/gbd-results/ and presented using R software (version 3.5.2; R Foundation for Statistical Computing).

Risk factors. The GBD study found strong evidence that gout was associated with high 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. 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]

Ethics. The present study was approved by the Ethics Committee of Tabriz University of Medical Sciences, Tabriz, Iran (IR.TBZMED.REC.1400.1168). Patient consent for publication was not required.

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

RESULTS

MENA. The number of prevalent cases of gout in 2019 was 2.5 million (95% UI 1.9-3.0 million), with an age-standardized point prevalence of 509.1 (406.0-633.9) per 100,000 population, which increased by 12% (10.1-13.9) between 1990 and 2019 (Table; Supplementary Table S1, available with the online version of this article). In 2019, there were 490,264 (95% UI 389,868 to 606,813) incident cases of gout in the MENA region, with an age-standardized rate of 97.7 (78.5-123.2) per 100,000 population, an increase of 11.1% (9.2-12.9) since 1990 (Table; Supplementary Table S2). Gout also accounted for 77,514 (95% UI 48,808 to 111,730) regional YLDs in 2019. Further, in 2019 the age-standardized YLD was 15.8 (95% UI 10.0-22.7) per 100,000 population, an increase of 11.7% (7.1-16.4) since 1990 (Table; Supplementary Table S3).

National level. In 2019, the national age-standardized point prevalence of gout ranged from 427.8 to 734.8 cases per 100,000 population among the MENA countries. Qatar (734.8, 95% UI 582.2-921.1), the UAE (664.8, 95% UI 525.4-831.2), and Kuwait (612.2, 95% UI 485.7-762.6) had the 3 highest age-standardized point prevalence rates of gout in 2019. In contrast, Yemen (427.8, 95% UI 340.5-534.9), Afghanistan (437.9, 95% UI 349.6-543.6), and Palestine (475.3, 95% UI 373.9-590.6) had the 3 lowest rates (Table and Figure 1A; Supplementary Table S1, available with the online version of this article).

The national age-standardized annual incidence rate of gout ranged from 84.1 to 137.0 cases per 100,000 population, with Qatar (137.0, 95% UI 109.7-174.1), the UAE (125.7, 95% UI 100.7-157.9), and Bahrain (115.4, 95% UI 91.6-144.3) having the highest rates. In contrast, Yemen (84.1, 95% UI 67.4-104.8), Afghanistan (85.9, 95% UI 68.8-108.9), and Palestine (91.5, 95% UI 72.8-115.3) had the lowest age-standardized annual incidence rates (Table and Figure 1B; Supplementary Table S2, available with the online version of this article).

In 2019, the national age-standardized YLD rate of gout ranged from 13.2 to 22.5 cases per 100,000 population among the MENA countries. The 3 highest rates were found in Qatar (22.5, 95% UI 14.5-32.7), the UAE (20.5, 95% UI 12.9-29.9), and Kuwait (19.0, 95% UI 11.7-27.6). Conversely, the countries with the lowest rates were Afghanistan (13.2, 95% UI 8.3-19.2), Yemen (13.3, 95% UI 8.4-19.5), and Palestine (14.6, 95% UI 9.1-21.2; Table and Figure 1C; Supplementary Table S3, available with the online version of this article).

The estimated percentage change in the age-standardized 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%, 95% UI 19.5-35.4), the UAE (20.3%, 95% UI 11.8-29.5), and Sudan (18.8%, 95% UI 11.7-25.7) had the largest estimated increases in the age-standardized point prevalence over the measurement period (Table; Supplementary Table S1 and Supplementary Figure S1, available with the online version of this article). Further, Oman (23.7%, 95% UI 16.4-32.3), the UAE (18.1%, 95% UI 10.5-25.2), and Qatar (16.7%, 95% UI 8.8-24.9) showed the largest increases in the age-standardized annual incidence rate over the same period (Supplementary Table S2 and Supplementary Figure S2). Similarly, most MENA countries had substantial increases in the age-standardized YLD rates, with Oman (26.6%, 95% UI 9.6-46.2), the UAE (19.6%, 95% UI 3.0-39.5), and Sudan (18.5%, 95% UI 2.7-34.6) having the highest increases over the measurement period (Table; Supplementary Table S3 and Supplementary 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- to 59-year-old and 60- to 64-year-old age groups for males and females, respectively (Figure 2A). Similarly, in 2019 the regional annual incidence rate of gout was highest in the age group ≥ 95 years for both sexes. The number of incident cases reached its peak in those aged 50 to 54 years and 55 to 59 years for males and females, respectively (Figure 2B). Further, a clear increase was observed in the regional YLD rates of gout for males and females up to the age group aged ≥ 95 years. Moreover, the number of YLDs were highest in the 50- to 54-year-old and 55- to 59-year-old 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-standardized 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-standardized rates for males and females and in all age groups, except for females aged 40 to 44 years in 2019 and females aged 45 to 59 years in 1990, which were the same as the global average (Figure 3). In 2019, females aged ≥ 80 years and males aged 30 to 69 years had the lowest rate ratios. Further, in 1990 females aged ≥ 85 years and males aged 30 to 34 years had the lowest age-standardized YLD rates, in comparison to the global average (Figure 3).

Association with SDI. The burden of gout from 1990 to 2019 increased dramatically with rising socioeconomic development. Several countries, such as Qatar, had much higher than expected burdens, whereas 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 BMI (46.1%) and

Table. Prevalent cases, incident cases, and YLDs due to gout in 2019 and the percentage change in the ASRs from 1990 to 2019.

	Prevalence (95% UI)			Incidence (95% UI)			YLDs (95% UI)		
	Counts, 2019	ASRs per 100,000, 2019	% Change in ASRs From 1990-2019	Counts, 2019	ASRs per 100,000, 2019	% Change in ASRs From 1990 to 2019	Counts, 2019	ASRs per 100,000, 2019	% Change in ASRs From 1990 to 2019
MENA	2,455,601 (1,940,521 to 3,045,022)	509.1 (406.0 to 633.9)	12 (10.1 to 13.9)	490,264 (389,868 to 606,813)	97.7 (78.5 to 123.2)	11.1 (9.2 to 12.9)	77,514 (48,808 to 111,730)	15.8 (10.0 to 22.7)	11.7 (7.1 to 16.4)
Afghanistan	67,747 (53,802 to 84,327)	437.9 (349.6 to 543.6)	9.1 (2.6 to 15.8)	14,470 (11,369 to 18,333)	85.9 (68.8 to 108.9)	9 (2.5 to 16.2)	2113 (1314 to 3066)	13.2 (8.3 to 19.2)	8 (−5.9 to 23.4)
Algeria	184,417 (145,466 to 232,406)	509.1 (399.3 to 637.9)	15.2 (8.3 to 22.4)	36,290 (28,880 to 45,641)	97.2 (77.3 to 122.6)	13.5 (6.8 to 19.7)	5822 (3632 to 8416)	15.9 (9.9 to 23)	14.9 (1.3 to 32.0)
Bahrain	9085 (7019 to 11,495)	611.5 (485.4 to 762.1)	14.3 (7.1 to 22.1)	1818 (1376 to 2311)	115.4 (91.6 to 144.3)	13.1 (6.6 to 20.3)	291 (180 to 434)	18.9 (12.0 to 27.5)	13.9 (−0.7 to 30.5)
Egypt	374,416 (293,642 to 470,254)	540.5 (430.3 to 674.5)	16.7 (10.4 to 23.5)	74,402 (59,281 to 92,868)	102.4 (82.2 to 128.5)	14.8 (8.8 to 21.5)	11,900 (7337 to 17,404)	16.9 (10.5 to 24.4)	16.3 (1.8 to 32.9)
Iran	390,085 (307,601 to 486,535)	489.3 (388.1 to 616.9)	7.5 (5.4 to 9.3)	78473 (61,932 to 98,315)	95.7 (76.2 to 121.4)	7.2 (5.4 to 9)	12,230 (7692 to 17,716)	15.2 (9.5 to 22)	7.5 (3.9 to 11.5)
Iraq	132,187 (103,630 to 163,705)	498.8 (395.2 to 619.9)	1.9 (−3.9 to 8.1)	26,852 (21,041 to 33,650)	95.6 (76.0 to 121.1)	2.8 (−2.8 to 8.7)	4159 (2661 to 5969)	15.4 (10.0 to 22.2)	2.5 (−10.5 to 17.2)
Jordan	42,332 (33,155 to 52,869)	543.6 (429.6 to 678.2)	14.2 (7.7 to 20.9)	8503 (6621 to 10,761)	103.3 (82.4 to 131.3)	13 (6.4 to 19.2)	1353 (837 to 1980)	17 (10.5 to 24.5)	14.2 (0.3 to 30.1)
Kuwait	22,340 (17,580 to 28,038)	612.2 (485.7 to 762.6)	6.5 (−0.5 to 15.2)	4469 (3420 to 5600)	113.5 (90.0 to 143.2)	4.7 (−1.6 to 12.0)	714 (432 to 1055)	19 (11.7 to 27.6)	5.2 (−7.0 to 20.7)
Lebanon	26,596 (21,125 to 33,162)	504.8 (400.9 to 633.2)	9 (2.6 to 15.6)	5069 (4058 to 6345)	95.7 (76.5 to 120.5)	7.7 (1.8 to 14.0)	821 (516 to 1182)	15.5 (9.8 to 22.5)	8.1 (−5.0 to 24.1)
Libya	31,013 (24,447 to 38,517)	525.6 (418.7 to 659.2)	3.8 (−2.1 to 9.9)	6174 (4849 to 7672)	100.1 (80.1 to 124.9)	3.8 (−2.1 to 9.9)	973 (598 to 1433)	16.2 (10.0 to 23.8)	2.3 (−10.2 to 16.5)
Morocco	157,478 (125,035 to 198,113)	476.3 (381.3 to 597.3)	11.7 (6.3 to 18.3)	31,153 (24,450 to 39,270)	92 (73.0 to 116.2)	10.8 (4.3 to 16.7)	4964 (3100 to 7149)	14.8 (9.2 to 21.5)	10.9 (−3.0 to 26.7)
Oman	16,883 (13,104 to 21,241)	574.8 (454.3 to 723.6)	27.1 (19.5 to 35.4)	3651 (2782 to 4600)	110.2 (87.7 to 138.6)	23.7 (16.4 to 32.3)	547 (338 to 798)	17.9 (11.2 to 25.7)	26.6 (9.6 to 46.2)
Palestine	13,342 (10,565 to 16,661)	475.3 (373.9 to 590.6)	8 (1.6 to 14.9)	2729 (2135 to 3400)	91.5 (72.8 to 115.3)	7.9 (2.0 to 13.8)	419 (260 to 603)	14.6 (9.1 to 21.2)	7.3 (−6.0 to 22.6)
Qatar	14,251 (10,929 to 18,189)	734.8 (582.2 to 921.1)	18.1 (10.0 to 27.2)	3048 (2311 to 3873)	137 (109.7 to 174.1)	16.7 (8.8 to 24.9)	461 (283 to 683)	22.5 (14.5 to 32.7)	16.4 (0.9 to 34.5)
Saudi Arabia	157,065 (122,656 to 199,612)	607.8 (483.0 to 760.2)	18.3 (11.0 to 25.4)	32,533 (24,732 to 40,855)	114.2 (91.4 to 143.5)	15.8 (9.7 to 22.8)	4996 (3196 to 7188)	18.6 (11.8 to 26.7)	17.5 (2.8 to 35.1)
Sudan	103,804 (81,093 to 129,860)	486.4 (383.9 to 615.4)	18.8 (11.7 to 25.7)	21,297 (16,849 to 26,431)	93.8 (74.8 to 119.4)	16.6 (9.7 to 23.3)	3288 (2104 to 4821)	15.1 (9.6 to 22)	18.5 (2.7 to 34.6)
Syrian Arab Republic	63,962 (50,266 to 81,403)	493.5 (393.2 to 623.2)	6 (0.3 to 12.1)	12,440 (9830 to 15,832)	94.1 (75.0 to 119.2)	5 (−0.7 to 10.6)	2003 (1243 to 2926)	15.3 (9.7 to 22.3)	4.5 (−8.9 to 19.7)
Tunisia	61,954 (48,867 to 78,282)	479.3 (380.9 to 602.7)	7.8 (1.8 to 15.0)	11,997 (9508 to 15,219)	92.2 (73.4 to 116.6)	7.4 (2.2 to 13.1)	1936 (1196 to 2795)	14.9 (9.2 to 21.5)	7.3 (−6.2 to 23.6)
Turkey	462,176 (364,077 to 573,854)	507.8 (400.6 to 634.6)	9.5 (3.6 to 15.2)	88,711 (70,737 to 111,000)	96.6 (77.2 to 121.7)	8.5 (3.0 to 14.4)	14525 (9000 to 21,308)	15.9 (9.9 to 23.3)	9.4 (−4.0 to 25.7)

Table. Continued.

	Prevalence (95% UI)			Incidence (95% UI)			YLDs (95% UI)		
	Counts, 2019	ASRs per 100,000, 2019	% Change in ASRs From 1990-2019	Counts, 2019	ASRs per 100,000, 2019	% Change in ASRs From 1990 to 2019	Counts, 2019	ASRs per 100,000, 2019	% Change in ASRs From 1990 to 2019
UAE	54,993 (40,988 to 71,980)	664.8 (525.4 to 831.2)	20.3 (11.8 to 29.5)	11,590 (8466 to 15,033)	125.7 (100.7 to 157.9)	18.1 (10.5 to 25.2)	1788 (1077 to 2712)	20.5 (12.9 to 29.9)	19.6 (3.0 to 39.5)
Yemen	66,982 (53,318 to 82,420)	427.8 (340.5 to 534.9)	12.6 (5.7 to 19.8)	14,099 (11,239 to 17,368)	84.1 (67.4 to 104.8)	11.5 (5.2 to 17.8)	2133 (1349 to 3134)	13.3 (8.4 to 19.5)	12.4 (−2.2 to 29.0)

Generated from data available from: https://vizhub.healthdata.org/gbd-results/. ASR: age-standardized rate; MENA: Middle East and North Africa; YLD: years lived with disability.

kidney dysfunction (18.8%) were the 2 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, whereas for females, these figures were 45.6% and 22%. The UAE had the largest burden of gout due to high BMI (61.9%), whereas 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%), whereas the UAE was estimated to have 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%), annual incidence (11.1%), and YLDs (11.7%) associated with gout over the period 1990 to 2019. The age-standardized burden of gout increased with advancing age, and it was significantly higher among men. Further, the burden of gout, as measured by the YLDs, was estimated to be positively associated with socioeconomic 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, whereas 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 from 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% to 12%, which was lower than other regions like Oceania, East Asia, and Southeast Asia[18]; this could be because some populations have inherently higher or lower levels of serum urate levels than others regardless of their obesity status. Further, there were geographic or ethnic differences reported in the occurrence of the disease across the world and differences in the modifiable and nonmodifiable risk factors, such as alcohol consumption, high BMI, 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 3 decades,[10] which could be partially responsible for the observed increases in the burden of gout during the same period. Moreover, the contribution of high BMI to the overall age-standardized DALYs in MENA increased by 52.2% over the period from 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. Further, the age-standardized 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, particularly

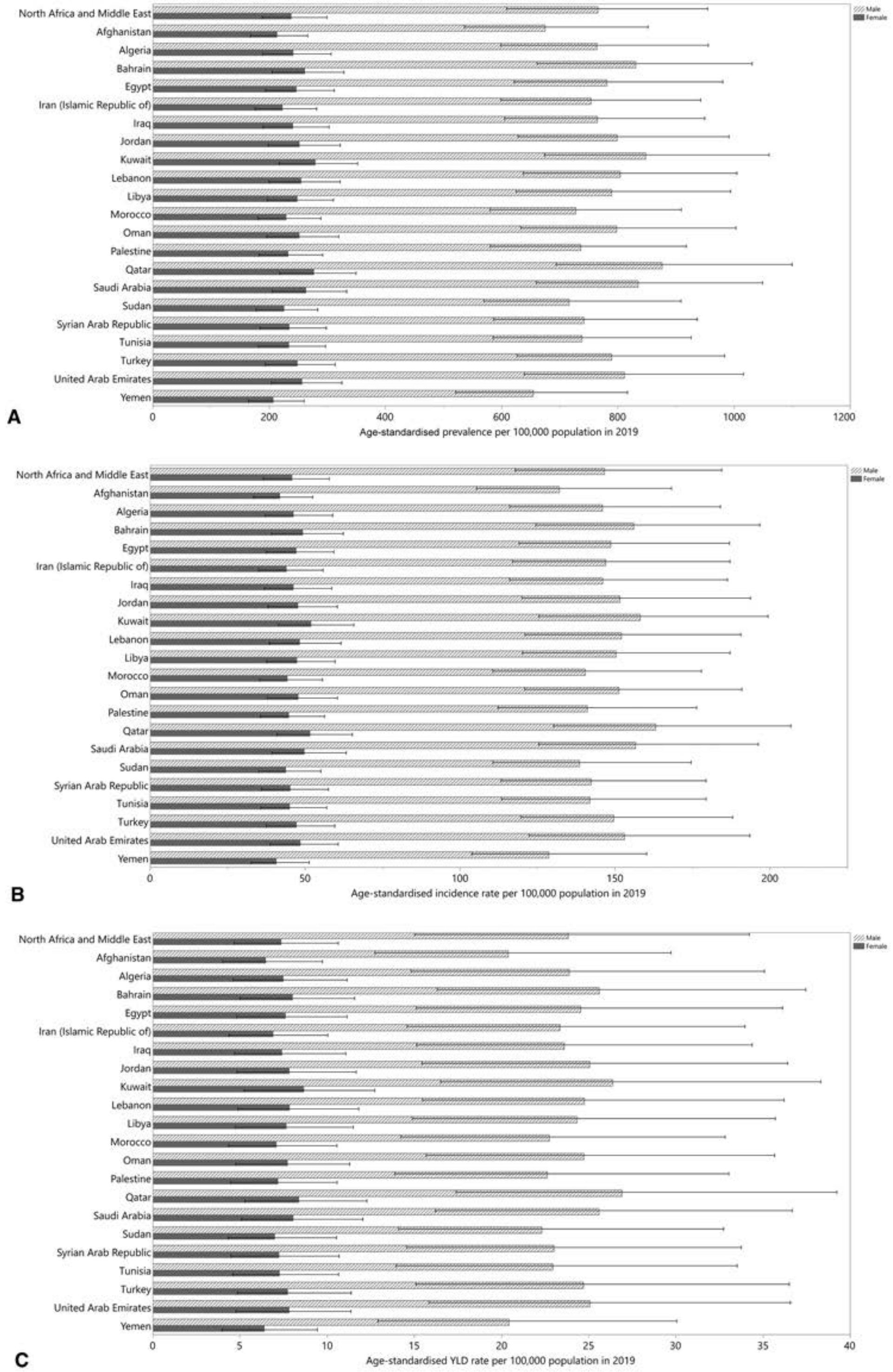

Figure 1. Age-standardized (A) point prevalence, (B) incidence, and (C) YLDs of gout per 100,000 population in the MENA region in 2019, by sex and country. Generated from data available from http://ghdx.healthdata.org/gbd-results-tool. MENA: Middle East and North Africa; YLD: years lived with disability.

diabetes.[22] The most effective strategies for the prevention and control of excess body weight focus on 2 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-standardized prevalence and DALY rates of gout were 790.9 and 23.2 per 100,000 population in males, respectively, whereas these rates were 253.5 and 7.2 per 100,000 population among females, respectively.[24] Further, the global age-standardized prevalence and YLD rates, for both

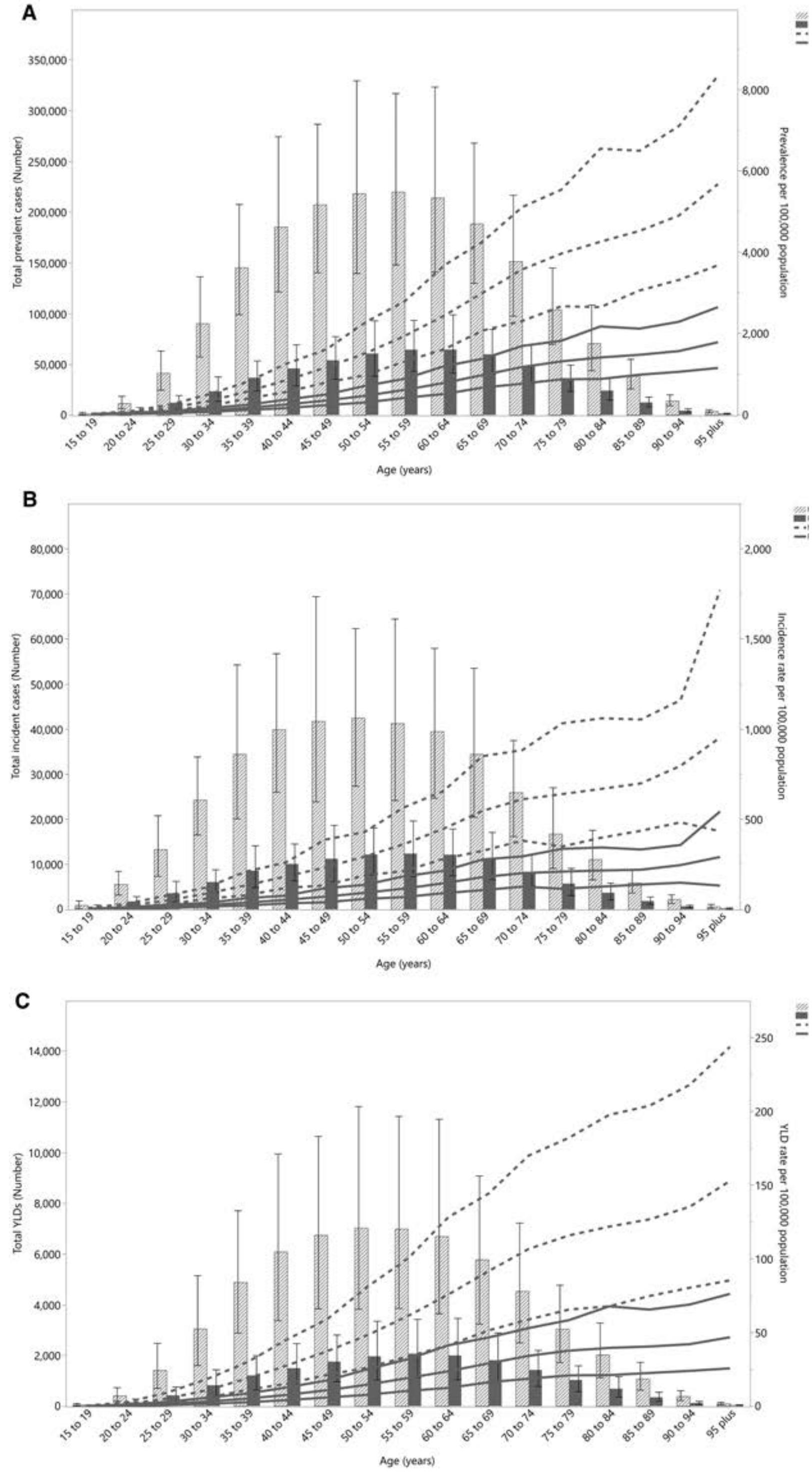

Figure 2. (A) The number of prevalent cases and prevalence, (B) the number of incident cases and incidence rate, and (C) the number of YLDs and YLD rate for gout per 100,000 population in the MENA region, by age and sex in 2019. Dotted and dashed lines indicate 95% upper and lower uncertainty intervals,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

sexes combined, were 510.6 and 15.9 per 100,000 population in 2017, respectively.[8] In comparison, in 2019 the age-standardized prevalence and YLD rates in MENA (509.1 and 15.8 per 100,000 population, 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-standardized 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

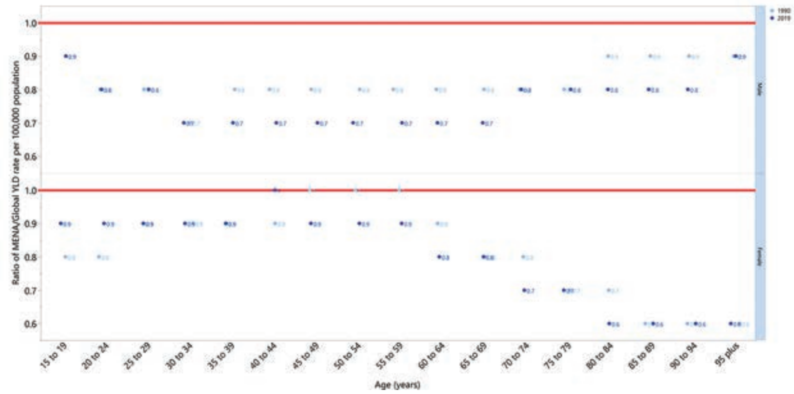

Figure 3. Ratio of the MENA region to the global gout YLD rate according to age group and sex, from 1990 to 2019. Generated from data available from http://ghdx.healthdata.org/gbd-results-tool. MENA: Middle East and North Africa; YLD: years lived with disability.

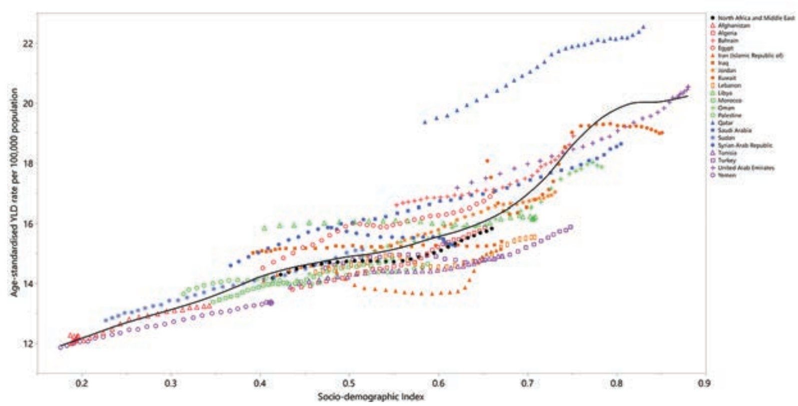

Figure 4. Age-standardized YLD rates of gout for 21 countries and territories by SDI in 2019. Expected values based on the sociodemographic index and disease rates in all locations are shown as the black line. Each point shows the observed age-standardized YLD rate for each country in 2019. Generated from data available from: https://vizhub.healthdata.org/gbd-results/. SDI: sociodemographic index; YLD: years lived with disability.

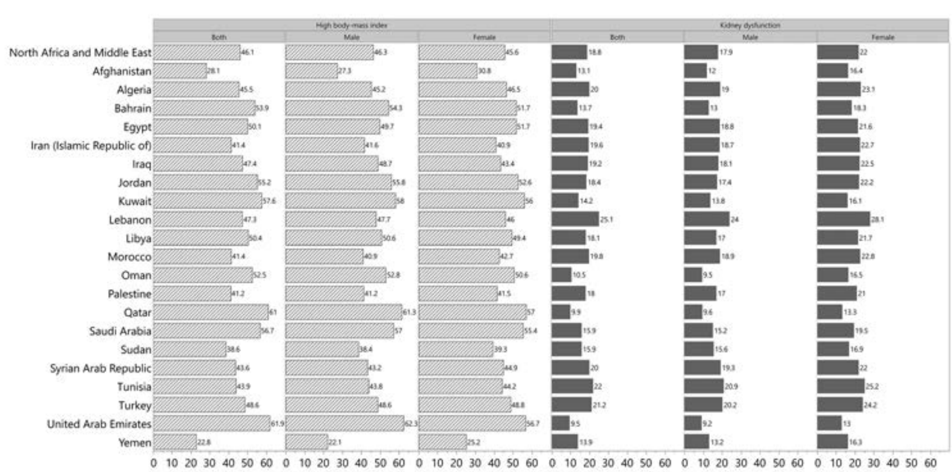

Figure 5. Percentage of YLDs due to gout attributable to risk factors for the MENA countries in 2019. Generated from data available from https://vizhub.healthdata.org/gbd-results. MENA: Middle East and North Africa; YLD: years lived with disability.

increase in exposure to the important risk factors in recent years, as mentioned earlier.

Qatar had the highest age-standardized point prevalence in 2019, followed by the UAE and Kuwait. This is likely due to a higher prevalence of overweight and obese individuals in these countries. Further, a study by Al-Thani and colleagues reported the prevalence of obesity and overweightness in Qatar from 2015 to 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 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-standardized 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 diet, 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 BMIs, higher serum uric acid, and increased 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-standardized 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-standardized 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 acids 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-standardized prevalence rate of gout in 2017 increased with advancing age, but the observed increase was higher in MENA specifically.[8] These findings might be a result of 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 (ie, 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 that contribute to the development of these disorders.[33,34] Further, the percentage change in the age-standardized prevalence per 100,000 population was higher in females over the period from 1990 to 2019, but further research is needed to determine the underlying reason for this.

The current study showed that the age-standardized 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-standardized YLD rate.[8] Further, the age-standardized DALYs attributable to musculoskeletal disorders were also positively related to SDI at the global and regional levels in 2017.[33] Therefore, preventive programs are needed for those who are middle-aged with regard to the identification and treatment of gout, particularly in countries with a high socioeconomic status.

This is the first study, to our knowledge, 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, sex, high BMI, alcohol consumption, genetic variations, and increased serum uric acid levels, which might be a result of 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. 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 underdiagnosis 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. Given 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.

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 from 1990 to 2017. However, the increase in the age-standardized YLD rate was higher in MENA than it was at the global level. Further, high BMI was one of the largest contributors to the regional burden of gout and 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.

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DATA SHARING POLICY

The data used for these analyses are all publicly available.

ONLINE SUPPLEMENT

Supplementary material accompanies the online version of this article.

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