Burden of Osteoarthritis in North Africa and Middle East from 1990 to 2019: The Findings from the Global Burden of Disease Study

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Research Article

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Abstract

Background

Considered the most common form of arthritis worldwide, Osteoarthritis (OA) prevalence has been continually due to the aging population and obesity. Based on the results of the last Global Burden of Disease (GBD) study, the North Africa and Middle East (NAME) was reported to have a high OA prevalence, hence the current study aimed to describe the burden and its attributable risk factors.

Methods

The OA was classified by kellgren Lawrence grading system. The burden (prevalence, incidence, and Years Lived with Disability (YLDs)) and attributable burden (YLDs) to high body-mass index (BMI) were reported based on GBD 2019 globally and for the 21 countries in the region by age, sex, and socio-demographic index (SDI).

Results

Globally, the age-standardized prevalence, incidence, and YLDs rates were estimated as 6348.3 (95% uncertainty interval 5776.3–7023.0), 492.2 (438.7-551.5), and 228.0 (115.3-452.7) per 100000, respectively. In the NAME region, the prevalence age-standardized rate (ASR) has increased by 9.3% (8.1–10.5) since 1990. Furthermore, the incidence ASR was estimated as 430.4 (382.2-481.9) in 2019 which has increased by 9.4% (8.3–10.5). Also, the YLDs ASR increased 10.0% (8.7–11.4); [185.4 (92.8-370.2) in 2019]. Among NAME countries, Saudi Arabia had the highest ASR followed by Kuwait and Iran in 2019 and Oman showed the highest increase from 1990 to 2019. The regional attributed YLDs increased by 57.6% (42.1–85.2).

Conclusion

As OA proves to have major public health impacts both globally and in the NAME region, health data and strategies must be improved to control the disease's burden better.

Background

As shown in a recent study, roughly 7% of the global population (more than 500 million people) suffer from osteoarthritis (OA). This number has risen 48% over the past decades from 1990 to 2019 (1). Since 1950, life expectancy has considerably increased globally from 48.1 years to 70.5 years for men and from 52.9 to 75.6 for women (2). The aging of the population, as well as other factors such as obesity, have greatly influenced the rise in OA's prevalence in recent decades (3). and today it is considered the most common form of arthritis (4).

The elderly population is predicted to reach 2 billion by 2050 globally (5). This increasing population will pose significant healthcare challenges for managing chronic diseases, especially in less developed countries (6).

Although the incident rate of OA is mainly expected to increase with age, many people under 65 years of age still experience OA and its related disabilities. Joint injury, certain occupations, obesity, and aberrant hip shape are key risk factors in young adults with OA (7). One of the known risk factors and currently believed to be a global epidemic, obesity is a major modifiable risk factor for OA, affecting the musculoskeletal system through both degenerative and inflammatory mechanisms (8, 9). According to the Global Burden of Disease (GBD) 2017 study, the Middle East and North Africa was ranked first for both mortality and Disability-Adjusted Life Years (DALYs) due to high body-mass index (BMI) and the prevalence of obesity in this region was higher than the global average (10).

While OA can involve many of the joints, it has a predilection for knees, hips, hands, first metatarsophalangeal (MTP) joints, and the facet joints of lower cervical and lower lumbar spine (11). As a degenerative joint disorder, OA can cause significant disability and chronic pain in the elderly which in turn can lead to activity limitation, sleep disturbance, fatigue, and depression (12, 13). In a study in France, OA was responsible for 22% of the difficulties in walking, 18.6% in carrying objects, and 12.8% in dressing (14).

Musculoskeletal disorders are a major and common component in multimorbidities due to their high prevalence and shared risk factors. A meta-analysis study revealed that musculoskeletal disorders may lead to the development of other chronic diseases; for example OA can cause a 16% increase in the risk of cardiovascular disease (15). Living with multiple chronic conditions (multimorbidities) is in turn associated with more health-service requirements and costs and poor work performance (16).
Trends of prevalence, incidence, and Years Lived with Disability (YLDs) for the OA in recent studies suggest that OA is becoming a growing global concern. The age-standardized prevalence of OA in 2017 was highest in high-income North America, North Africa and Middle East (NAME), and Australasia (17, 18). Despite the high disease in this manuscript, hence for the first time in current manuscript, GBD study 2019 was used to report updated descriptions of prevalence, incidence, and YLDs for OA based on age and sex in the NAME region. Furthermore, the data was compared among NAME countries to analyze the socioeconomic determinants of burden. Finally, as proper recognition of risk factors and their burden is vital for health decision making and prevention attributable risk factors were also reviewed in order to achieve a comprehensive report regarding OA.

Methods

GBD provides comprehensive, and up-to-date, epidemiological information on 369 diseases and 87 risk factors for 204 countries. GBD 2019 includes global, regional, national, and subnational data that is developed by the Institute for Health Metrics and Evaluation (IHME) in Seattle, Washington, USA (19, 20).

GBD 2017 defines OA as a symptomatic arthritis at the hip or knee that has been confirmed radiologically based on the Kellgren Lawrence grading (21) in which grade 0 shows no x-ray changes regarding OA, grade 1 has minimal joint space narrowing and possible osteophytes, grade 2, definite osteophytes and possible joint space narrowing, grade 3, moderate osteophytes, definite joint space narrowing, some sclerosis and possible deformity, and grade 4 also has large osteophytes, marked narrowing of joint space, severe sclerosis and definite deformity of bone. A definite diagnosis of OA is considered at grade 2 (22).

GBD 2019 adds two new sites for OA which have been included in current study: hand, and “other sites” (eg, foot, shoulder, wrist). Although spine is another common site for OA but, it is usually discussed in the studies covering estimates of low back pain and neck pain (19). Based on the tenth revision of the international classification of diseases (ICD), the codes used for OA include M16-M16.9 for OA in the hip, M17-M17.9 for OA of the knee, and M18-M18.9 for hand OA (23). In this study, prevalence, incidence, and YLDs for OA overall and by hip, knee, hand, and other OA were extracted from GBD Results Tool (https://ghdx.healthdata.org/gbd-results-tool) and GBD Compare Tool (https://vizhub.healthdata.org/gbd-compare/).

Incidence, prevalence, remission, and cause of death were estimated with the use of DisMod-MR, a Bayesian meta-regression disease-modeling tool. The detailed methodology has been published previously (24, 25).

Additionally, GBD employs the comparative risk assessment (CRA) methodology to provides attributable mortality, YLLs, YLDs, and DALYs for 84 risk factors by multiplying population attributable fractions (PAFs). As high BMI is considered a modifiable risk factor attributed to OA in the GBD 2019, we also evaluated the estimates for high BMI (20).

Overall, results were reported for a total of 21 countries in the region (Afghanistan, Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, Tunisia, Turkey, United Arab Emirates, and Yemen) between 1990 and 2019 and were classified by sex, 5-year intervals age groups (30–34, 35–39, ..., 65–69, and 70 + years of age), and metric (number and rate) were also reported. Estimates were reported as age-standardized values as well to compare countries’ estimates. Socio-demographic index (SDI) is a combined indicator of the ranking of the income per capita, average educational attainment, and fertility rates. The variation of association between SDI and the aforementioned OA metrics with the level of SDI were also performed and reported.

Lastly, a decomposition analysis was also carried out to report contribution of population growth, age structure change, and incidence rate change to the overall new cases changes between 1990–2019 (26).

Such a study is designed to show the changes of OA burden and its related risk factor during past three decades and interpreted the changes with 95% uncertainty intervals (UIs) for every metric.

Results

Global level

In GBD 2019, the global age-standardized prevalence of OA was estimated to be 6348.3 (95% UI 5776.3-7023.0) per 100000 for both sexes. Knee OA had a prevalence of 4376.0 (3793.0-5004.9) while hand OA ranked second with a prevalence of 1726.4 (1319.9-2254.9). The age-standardized incidence and YLDs rates were 492.2 (438.7-551.5) and 228.0 (115.3-452.7) respectively. Figure 1 depicts the global prevalence, incidence, YLDs rates compared with those of the NAME region between 1990 to 2019 in both sexes.

Regional level

Prevalence
The age-standardized prevalence rate of OA increased by 9.3% (8.1-10.5) from 4889.5 (4404.9-5422.3) in 1990 to 5342.8 (4815.9-5907.8) in 2019 which was higher in females (5925.1; 5326.4-6569.0) compared with males (4786.2; 4300.3-5304.3). See Table 1 and Figure 1 for more details.

Among 21 countries in the NAME region, Saudi Arabia had the highest age-standardized prevalence rate (6601.3; 5941.5-7358.3), followed by Kuwait (5627.6; 5049.7-6251.9) and Iran (5558.2; 5041.2-6228.6). The age-standardized prevalence rate was lowest in Yemen (4770.5; 4293.7-5293.9). These values are further detailed in Figure 2.

From 1990 to 2019, Oman showed the greatest age-standardized prevalence change by 14.6% (11.3-18.1) whereas Iraq had the lowest prevalence change of around 4.3% (1.2-7.5) (Supplementary Table 1).

In both sexes, knee was the most common site for OA and the age-standardized prevalence rate for knee was 3863.7 (3321.6-4440.7). Hand (931.6; 696.9-1247.9), other sites (818.2; 612.1-1036.4) and hip (280.2; 216.0-353.6) ranked second to fourth, respectively. More detailed information, as well as the values by sex are provided in Supplementary Table 2.

Incidence

The age-standardized incidence rate in NAME was estimated to be 430.4 per 100000 (382.2-481.9) in 2019 which showed an increase of 9.4% (8.3-10.5) since 1990. The rate was higher in females (478.3; 424.7-537.0) compared with males (386.1; 344.3-430.6) (Table 1).

In 2019, Saudi Arabia ranked first in age-standardized incidence rate with an incidence of 504.0 (447.9-565.1). After Saudi Arabia, Kuwait (451.6 per 100000; 400.4-505.7), and Iran (445.0 per 100000; 395.4-501.9) had the highest age-standardized rates respectively. Among NAME countries, the highest age-standardized incidence rate change between 1990 and 2019 belonged Oman (14.4%; 10.9-18.2) while Palestine showed the lowest change (4.3%; 1.0-7.6) (Figure 2).

About 74.0% of the incidence rate was due to knee OA with a value of 320.2 per 100000 (276.7-365.6) which ranked first in either of the sexes. Hand OA ranked second in females (70.1; 52.8-92.0) whereas “other sites” OA was the second most common OA in males (Supplementary Figure 1).

YLDs

The age-standardized YLDs rates due to OA increased 10.0% (8.7-11.4) from 168.6 (84.4-336.8) per 100000 in 1990 to 185.4 (92.8-370.2) in 2019. In 2019, the age-standardized YLDs rate were 206.6 (103.8-406.2) in females and 166.2 (83.0-329.1) in males (Table 1).

The highest YLDs was observed in Saudi Arabia with a value of 233.1 (118.8-457.8) and Yemen had the lowest YLDs rate per 100000 (163.7; 82.1-326.0). A time trend for the burden of OA in NAME countries from 1990 to 2019 is depicted in Figure 2.

Among NAME countries, Oman (15.9%; 11.9-20.1), Sudan (13.4%; 9.4-17.6), and Turkey (11.1%; 6.9-15.9) showed the most increase in burden respectively.

Overall, knee OA was responsible for 122.0 per 100000 (60.2-247.3) age-standardized YLDs in both sexes and hip OA had the highest percentage change 23.3% (19.2-27.6) between 1990 and 2019 (Supplementary Figure 1).

Age pattern

In our study a linear correlation was found between prevalence, incidence, YLDs and age. Older people had higher values of prevalence, incidence, and YLDs during the study period from 1990 to 2019.

The correlation between age and OA is depicted in Supplementary Figure 2.

Incidence peaked at 50-54 years age for both sexes both in global and in NAME. The prevalence and DALY rates showed positive correlation with age (Supplementary Table 3). Saudi Arabia had the highest prevalence and DALY rates. Supplementary Tables 4,5 and 6 show the age-related incidence, prevalence, DALY rates in NAME countries between 1990 and 2019.

Attributed burden to risk factors

The BMI was the only attributable risk factor for OA in GBD 2019. 43.7 (18.0-96.0) age-standardized YLDs rates per 100000 were attributed to high BMI in NAME for both sexes which had increased 57.6% (42.1-85.2) from 1990 to 2019. The rate was higher in females (52.4; 20.8-116.3) compared with males (35.4; 13.3-77.0) but males had a higher percentage of change (78.5%; 54.2-129.1) than that of females (46.2%; 34.2-67.2) during the same period (Table 2).
Among the 21 countries in NAME, Qatar had the most high-BMI attributable YLDs with a value of 59.8 per 100000 (25.6-123.3) followed by Kuwait (59.6; 25.5-126.3) and United Arab Emirates (56.8; 24.1-117.5). On the other hand Yemen showed the lowest value (18.7; 6.4-42.8).

All countries showed an increasing trend during the 1990-2019 period and Oman had the largest increase of attributed YLDs to BMI (155.3%; 96.1-287.6) (Figure 3 and Supplementary Table 7).

SDI

A non-linear association was observed between the incidence, prevalence, YLDs and SDI. The highest age-standardized rates were recorded in high SDI countries including Saudi Arabia and Kuwait while low SDI countries such as Yemen and Afghanistan had the lowest age-standardized rates. Iran was a low-middle SDI with high rates (Figure 4).

Decomposition analysis

Although the decomposition analysis revealed that 86.1% of new cases in NAME could be attributed to age structure changes, in some countries population growth had a higher contribution compared to age-structure. Also, Afghanistan showed the lowest population growth contribution among the countries in the region (Supplementary Table 8).

Discussion

In current study, the prevalence, incidence, and YLDs for OA were evaluated in global, regional and in 21 countries of the NAME region. Based on the results, age-standardized prevalence, incidence, and YLDs rates had increased from 1990 to 2019 in both the global and NAME region. Such a finding is in accordance with previous studies which had also showed an increasing trend. Notably, the global rates have nearly doubled since 2017.

On a regional level, NAME had the highest disease prevalence in 2017 and the percentage changes in age-standardized prevalence, incidence, and YLDs were estimated to be 12.8%, 12%, and 13.4% respectively which were all higher than those of the global rates (17). This is in contrast to our findings in which the NAME region was found to have lower rates than global and percentage changes in the rates of age-standardized prevalence, incidence, and YLDs were 9.3%, 9.4%, and 10.0% from 1990 to 2019. In our results, Saudi Arabia, Kuwait and Iran had the highest age-standardized prevalence, incidence, and YLDs rates. A meta-analysis study by Alenazi et. al. had also shown a high prevalence of OA in Gulf Cooperation Council countries such as Saudi Arabia, Kuwait, and Qatar. Such a considerably higher prevalence compared with other nations in the world as well as the fact that several risk factors including high BMI, high blood pressure, aging, occupation, female gender, and quality of life were found to be associated with OA may point to a cultural or lifestyle element exacerbating the problem in this region (27).

As shown in previous studies, GBD 2019 also reported that OA had higher prevalence, incidence, and YLD rates in women. Such a sex difference may be explained by a number of variables such as hormonal changes, BMI, physical activity (28).

A careful assessment of OA risk factors is essential for preparing effective prevention strategies so in addition to the burden of OA we also evaluated its attributable risk factors. In GBD 2019, high BMI was the only attributable risk factor to OA. Obesity is an established and major OA risk factor that leads to the disease both by mechanical and metabolic stress (29). Although there is a strong relationship between knee OA and obesity, its effect is not limited to the knee and several studies have reported an increased risk of hand and hip OA in obese individuals (30, 31) Inflammatory mediators produced by adipocytes may play an important role in this process (32).

Based on the results of our study, the countries with the highest OA rates also had the highest BMI attributable YLDs.

According to a recent study, Middle East and North Africa was adetermined as the region with the highest burden resulting from metabolic risk factors In 2016, the prevalence of obesity was estimated to be more than 30% in women and 20% in men and was higher than global prevalence. The sex difference in obesity was also significant in Middle East and North Africa compared with the global average. In our study females also had higher attributable YLDs to BMI. Also, Middle East and North Africa was one of the worst regions in the world in regard with physical activity especially in women (10) such a result may be due to a lack of social support, or presence of environmental barriers, and cultural stigma (33).

Several studies have evaluated the association between SDI and OA globally (17, 34–36). In GBD 2017, in addition to high SDI regions, some other countries and regions also had a more than expected OA prevalence including middle SDI countries with a high life expectancy (17).

In GBD 2019 there was a nonlinear association between SDI and OA. Saudi Arabia (high-SDI) had the highest rates but some low-middle SDI countries such as Iran also showed high rates of the disease. The fact that the relationship between SDI and OA is variable and complex in different studies further suggests the importance of other modifiable risk factors (34–36).

Strengths And Limitations
A comprehensive evaluation of disease burden in OA, especially in the NAME region was carried out by this study. Moreover, all the countries in the region were individually evaluated and compared with one another. Also of note is the inclusion of the two newly included OA sites in current study which helps to yield a more accurate estimate of the true burden of OA. As for the limitations, in GBD 2019, the only attributable risk factor to OA was reported to be high BMI. Nevertheless, other risk factors could be attributed to OA. It is expected that future GBD studies will include the other risk factors as well.

Conclusions

According to the results, in the years between 1990 to 2019, the prevalence, incidence, and YLDs rates for OA increased both globally and in the NAME region and such an increasing trend is expected to continue in the years to come. Furthermore, high BMI is recognized as the most important modifiable risk factor for OA. Ultimately, as OA qualifies as a major concern in today’s health care, improving data gathering and analysis, as well as strategy planning and policy making is necessary to better monitor and manage this increasing trend.

Abbreviations

BMI
Body-Mass Index
CRA
Comparative Risk Assessment
DALYs
Disability-Adjusted Life Years
GBD
Global Burden of Disease
ICD
International Classification of Disease
IHME
Institute for Health Metrics and Evaluation
MTP
metatarsophalangeal
NAME
North Africa and Middle East
OA
Osteoarthritis
SDI
Socio-Demographic Index
UI
Uncertainty Interval
YLDs
Years Lived with Disability

Declarations

Ethics approval
Not Applicable

Consent for publication
Not Applicable

Availability of data and materials

The datasets used during the current study are available in the GBD Results Tool (https://ghdx.healthdata.org/gbd-results-tool) and GBD Compare Tool (https://vizhub.healthdata.org/gbd-compare/).

Competing interests

All authors declare no conflict of interest.
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Authors’ contributions

MS, SY, SSM, and BL designed the study. SSM, YST, and NA analysed the data and performed the statistical analyses. MS, SY, SN, and HY drafted the initial manuscript. KS, SSM, NF, M-MR, AO, and BL revising the work for important intellectual content. All authors reviewed the drafted manuscript for critical content. All authors approved the final version of the manuscript.

Acknowledgments

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References


Tables

Table 1. Regional all ages (number) and age-standardized rate of osteoarthritis burden with percent change
### Incidence

<table>
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<th>Female</th>
<th>Male</th>
<th>Both</th>
<th>Female</th>
<th>Male</th>
<th>Both</th>
<th>Female</th>
<th>Male</th>
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<tbody>
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<td>Incidence</td>
<td>All ages</td>
<td>1990</td>
<td>795083 (705541)</td>
<td>431408 (381427) to (487612)</td>
<td>363674 (322626) to (408421)</td>
<td>2292214 (2035506) to (2570668)</td>
<td>1224174 (1083549) to (1379130)</td>
<td>1068040 (948928) to (1197627)</td>
<td>188.3 to (192.2)</td>
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<td>2019</td>
<td>393.5 (348.5) to (442.2)</td>
<td>436.6 to (387.1) (492.2)</td>
<td>352.4 to (314.8) (394.2)</td>
<td>430.4 to (382.2) (481.9)</td>
<td>478.3 to (424.7) (530.7)</td>
<td>386.1 (434.1) to (430.6)</td>
<td>9.4 to (8.7)</td>
<td>9.8 to (11.0)</td>
<td>9.6 to (11.2)</td>
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Data in parenthesis are 95% Uncertainty Interval (95% UI); YLDs = Years Lived with Disability

### Prevalence

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<tr>
<td>Prevalence</td>
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<td>1990</td>
<td>8682345 (7793117)</td>
<td>4739201 (4253663) to (5300776)</td>
<td>3943144 (3522566) to (4404960)</td>
<td>24604611 (22080960) to (27327135)</td>
<td>13272059 (11904574) to (14783765)</td>
<td>11332552 (10154001) to (12663002)</td>
<td>183.4 to (186.8)</td>
<td>180.0 to (184.1)</td>
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<td>2019</td>
<td>4889.5 (4404.9) to (5422.3)</td>
<td>5416.6 (4879.0) to (6018.3)</td>
<td>4372.4 (3932.7) to (4843.3)</td>
<td>5342.8 to (4815.9) (5907.8)</td>
<td>5925.1 to (5326.4) (6569.0)</td>
<td>4786.2 (5304.3) to (630.3)</td>
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### YLDs

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<td>461728 (232257) (914017)</td>
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<td>168.6 to (84.4) (336.8)</td>
<td>187.4 to (94.3) (370.3)</td>
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<td>206.6 to (103.8) (406.2)</td>
<td>165.2 to (83.0) (329.1)</td>
<td>10.0 to (8.7)</td>
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<td>9.9 to (11.8)</td>
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Data in parenthesis are 95% Uncertainty Interval (95% UI); YLDs = Years Lived with Disability

### Change (1990 to 2019 %)

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<tr>
<td></td>
<td>((number)</td>
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<td>Female</td>
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<tr>
<td>All ages</td>
<td>50793 (19621 to 113701)</td>
<td>32168 (11728 to 73593)</td>
<td>18626 (6309 to 41895)</td>
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<td>Age-standardized rate (per 100000)</td>
<td>27.7 (10.7 to 61.7)</td>
<td>35.9 (13.2 to 81.7)</td>
<td>19.8 (6.7 to 44.7)</td>
</tr>
</tbody>
</table>

Data in parenthesis are 95% Uncertainty Interval (95% UI); YLDs = Years Lived with Disability

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**Figures**
Figure 1

Global and regional age-standardized incidence, prevalence, and YLDs rate of osteoarthritis by site
Figure 2
Ranking of NAME countries based on the osteoarthritis burden in 1990 and 2019
Figure 3

Age-standardized YLDs rate attributed to high BMI, 1990 and 2019
Figure 4
Age-standardized burden of osteoarthritis in the NAME countries by SDI quintile in 1990 and 2019

Supplementary Files
This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFigure1.pdf
- SupplementaryFigure2.pdf
- SupplementaryTable1.pdf
- SupplementaryTable2.pdf
- SupplementaryTable3.pdf
- SupplementaryTable4.pdf
- SupplementaryTable5.pdf
- SupplementaryTable6.pdf
- SupplementaryTable7.pdf
- SupplementaryTable8.pdf