INTRODUCTION

Iran has a population of 78 million and is the second most populated country in the Middle East and North Africa (MENA). About half of the population is under 35 years old. In the last two decades, the life expectancy at birth has increased by approximately 7 years and reached 74.4 (95% confidence interval [CI]: 72.2–76.6) years in 2010. Iran has experienced demographic and epidemiological transitions that could change the patterns of morbidity and mortality in the near and distant future. These changes involve the emergence of chronic noncommunicable diseases and health-related conditions of an aging population. This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

Key words: Blinding Eye Diseases, Disability-Adjusted Life-Years, Global Burden of Diseases, Iran

ABSTRACT

Purpose: The disability-adjusted life-years (DALYs) lost due to eye diseases and trends in DALYs in Iran has not been previously reported. The object of this study is to report the burden of eye diseases in Iran and to compare changes from 1990 to 2010 based on age and gender.

Methods: Data from the Global Burden of Disease Study 2010 (GBD 2010) are used to report DALYs for cataract, refraction/accommodation (functional) disorders, macular degeneration, and glaucoma.

Results: Cataract, refraction/accommodation (functional) disorders, macular degeneration, and glaucoma were the 84th, 87th, 138th, and 151st causes of DALY in 1990 and the 89th, 72nd, 99th, and 137th in 2010, respectively. Cataract accounted for 0.085% of national DALY in 1990 and 0.09% in 2010, refraction/accommodation (functional) disorders accounted for 0.42% in 1990 and 0.47% in 2010, macular degeneration accounted for 0.017% in 1990 and 0.071% in 2010 and glaucoma accounted for 0.0099% in 1990 and 0.025% in 2010. There was a steady increase in DALY with age for each eye disease for both genders and dichotomized for males and females from 1990 to 2010.

Conclusions: Epidemiologic transition is reflected in major ophthalmic and blinding diseases in the GBD data for Iran. The burden of macular degeneration is rising, followed by glaucoma. The burden of presbyopia affected individuals past their middle age. The burden of cataract manifested as a slower increase that could be attributable to better access to treatment.

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transition has resulted in a shift in the allocation of health resources and health policy.

In the past 20 years, there has been a reduction in the age-standardized prevalence of blindness and moderate and severe vision impairment (MSVI) worldwide. While the blind population remained stable, the population with MSVI may have increased. This pattern could be related to population growth and the relative increase in the population of older adults. The most recent Rapid Assessment of Avoidable Blindness study among noninstitutional inhabitants aged ≥50 years in Tehran estimated the standardized prevalence rate of blindness, severe visual impairment (VI), and VI to be 1.33 (95% CI: 0.91–1.75), 1.39 (95% CI: 0.81–1.97), and 6.91 (95% CI: 5.96–7.86), respectively. These figures are slightly higher than the more recent (2010) age-standardized prevalence of blindness of 1.1% and moderate and severe VI of 4.5% in the North Africa and the Middle East, respectively.

Advocacy for the prevention of blindness relies on data on the prevalence and burden of blindness and VI, the major avoidable causes, and the natural trends over time. Currently, there are no published data on the burden of blindness and VI in Iran. In the current study, we investigate and report disability-adjusted life-years (DALYs) lost due to four major eye diseases in Iran and compare changes in the burden from 1990 to 2010 based on gender and age using the Global Burden of Disease Study 2010 (GBD 2010) results.

GBD 2010 began in 2007 as a collaborative project with the Institute for Health Metrics and Evaluation (IHME) at the University of Washington as the coordinating center working with six other core collaborators including the University of Queensland, Harvard School of Public Health, the Johns Hopkins Bloomberg School of Public Health, the University of Tokyo, Imperial College London, and the World Health Organization. This study provides a new platform for assessing the world’s biggest health challenges.

METHODS

We report DALYs in Iran for eye diseases using the GBD 2010 outcomes. The GBD 2010 data includes DALYs, years lived with disability (YLDs), and years of life lost (YLLs) for each specific disease. Measurement of the GBDs using DALYs requires weights that quantify disabilities (or health losses) for all nonfatal consequences of diseases and injuries in terms of years lost. Judgment about health losses associated with eye diseases and injuries is elicited from the general public in diverse communities through a new, standardized approach.

In the GBD 2010 study, eye diseases are categorized under sense organ diseases that include cataract, refraction/accommodation (functional) disorders, macular degeneration, glaucoma, other vision loss, other hearing loss, and other sense organ diseases. In this study, we focus on the first four eye diseases. Due to their nonfatal nature, there are no YLLs attributed to eye diseases; hence, DALYs and YLDs have the same values. We report the rate of DALYs for 100,000 populations to adjust for the changes in the age distribution over years. We compare DALYs for each eye disease between 1990 and 2010 and among 20 age groups from early neonatal (EN) phase to 80 years of age and older and separately for males and females. The age groups are defined in Table 1.

RESULTS

Table 2 presents absolute, as well as the percentage values of DALYs attributed to four eye diseases. It also provides global figures and those from the MENA region for comparison.

Cataract

In 1990, DALY attributed to cataract per 100,000 population of Iran ranged from 0 in EN to 1.97 (95% UI; 0.71, 4.01) for ages 20–24 years and 681.41 (95% UI; 497.04, 901.58) for age 80 years and older for both sexes. There was a steady increase in DALY attributed to cataract with age from EN to 80+ years and among males and females [Graph 1] with the highest DALY of 631.07 (95% UI; 444.47, 883.29) among males aged 80 years and older and the highest DALY of 726.71 (95% UI; 507.95, 999.5) among females aged 80 years and older. In 2010, DALY attributed to cataract per 100,000 population ranged from 0 in EN to 0.93 (95% UI; 0.21, 1.96) for ages 20–24 years and 318.32 (95% UI; 231.84, 428.15) for age 80 years and older for both sexes. There was a steady increase in DALY attributed to cataract with age [Graph 1] with the highest DALY of 338.77 (95% UI; 217.94, 491.85) among females aged 80 years and older. The point-by-point comparison of DALY attributed...
to cataract showed a decrease for each specific age group from 1990 to 2010 for both sexes and in males and females [Graph 1].

**Refraction/accommodation (functional) disorders**

In 1990, the DALY attributed to functional disorders per 100,000 population of Iran ranged from 0.8 (95% UI; 0.2, 2.57) in EN to 17.82 (95% UI; 11.39, 25.66) for ages 10–14 years, 10.26 (95% UI; 6.17, 15.27) for ages 20–24 years, and 555.56 (95% UI; 410.7, 732.13) for 80 years and older for both genders. There was a steady increase in DALY attributed to refraction/accommodation (functional) disorders with age from EN to 10–14 years old and a slight decrease thereafter until the age of 20–24 years. The attributed DALY had a steady increase from ages 40 to 80+ years in both genders [Graph 2 top row] with the highest DALY of 505 (95% UI; 354.18, 695.23) among males aged 80 years and older and the highest DALY of 601.63 (95% UI; 430.15, 812.2) among females aged 80 years and older. In 2010, DALY attributed to refraction/accommodation (functional) disorders per 100,000 population ranged from 0.7 (95% UI; 0, 2.48) in EN to 16.45 (95% UI; 10.53, 24.49) for ages 10–14 years, 9.81 (95% UI; 6.06, 14.83) for ages 20–24 years, and 531.37 (95% UI; 393.2, 708.46) for ages 80 years and older for both genders. The DALY trend by age was similar to 1990 data with the highest DALY of 484.6 (95% UI; 345.81, 670.35) among males aged 80 years and older and the highest DALY of 584.09 (95% UI; 409.87, 797.63) among females aged 80 years and older. The point-by-point comparison of DALY attributed to refraction/accommodation (functional) disorders showed a slight decrease for each specific age group from 1990 to 2010 for both genders and among males and females. The change was larger in the older age groups compared to younger age groups [Graph 2].
Macular degeneration

In 1990, DALY attributed to macular degeneration per 100,000 population of Iran ranged from 0 in EN to 2.36 (95% UI; 0.88, 4.29) for ages 45–49 years and 343.02 (95% UI; 241.49, 470.45) for age 80 years and older for both genders. There was a steady increase in DALY attributed to macular degeneration with age from EN to 80+ years in both genders and among males and females [Graph 3 top row] with the highest DALY of 269.73 (95% UI; 163.20, 410.33) among males aged 80 years and older, and the highest DALY of 409.81 (95% UI; 270.26, 589.98) among females aged 80 years and older. In 2010, DALY attributed to macular degeneration per 100,000 population ranged from 0 in EN to 4.35 (95% UI; 1.97, 7.79) for ages 45–49 years and 522.5 (95% UI; 379.16, 696.88) for age 80 years and older for both genders. There was a steady increase in DALY attributed to macular degeneration with age from EN phase to 80+ years in both genders and among males and females [Graph 3 bottom row] with the highest DALY of 269.73 (95% UI; 163.20, 410.33) among males aged 80 years and older, and the highest DALY of 409.81 (95% UI; 270.26, 589.98) among females aged 80 years and older. In 2010, DALY attributed to macular degeneration per 100,000 population ranged from 0 in EN to 4.35 (95% UI; 1.97, 7.79) for ages 45–49 years and 522.5 (95% UI; 379.16, 696.88) for age 80 years and older for both genders. There was a steady increase in DALY attributed to macular degeneration with age from EN phase to 80+ years in both genders and among males and females [Graph 3 top row] with the highest DALY of 269.73 (95% UI; 163.20, 410.33) among males aged 80 years and older, and the highest DALY of 409.81 (95% UI; 270.26, 589.98) among females aged 80 years and older. The point-by-point comparison of DALY attributed to macular degeneration showed an increase for each specific age group from 1990 to 2010 for both genders together and among males and females separately [Graph 3].

Glaucoma

In 1990, DALY attributed to glaucoma per 100,000 population of Iran ranged from 0 in EN to 0.11 (95% UI; 0, 0.51) for ages 20–24 years and 116.52 (95% UI; 73.75, 172.68) for age 80 years and older for both genders. There was a steady increase in DALY attributed to glaucoma with age from EN to 80+ years in both sexes and among males and females [Graph 4 top row] with the highest DALY of 447.61 (95% UI; 306.74, 645.45) among males aged 80 years and older, and the highest DALY of 133.57 (95% UI; 74.05, 213.47) among males aged 80 years and older, and the highest DALY of 100.99 (95% UI; 58.34, 171.53) among females aged 80 years and older. In 2010, DALY attributed to glaucoma per 100,000 population ranged from 0 in EN to 0.19 (95% UI; 0, 0.69) for ages 20–24 years and 112.56 (95% UI; 73.69, 162.53) for age 80 years and older for both genders. There was a steady increase in DALY attributed to glaucoma with age from EN phase to 80+ years in both genders and among males and females [Graph 4 bottom row] with the highest DALY of 447.61 (95% UI; 306.74, 645.45) among males aged 80 years and older, and the highest DALY of 133.57 (95% UI; 74.05, 213.47) among males aged 80 years and older. The point-by-point comparison of DALY attributed to glaucoma showed a slight change for each specific age group from 1990 to 2010 for both genders and among males and females with a slight decrease in some age groups and slight increase in others [Graph 4].

DISCUSSION

In 2010, noncommunicable diseases accounted for 70.42% (95% UI; 67.36, 73.08) and eye diseases accounted for 0.64% (95% UI; 0.9, 1.68) of national DALY in Iran. During the same time period, eye diseases accounted for 1.05% and 0.76% of national DALY in the MENA region and worldwide, respectively.

Among the four eye diseases studied, the burden of refraction/accommodation (functional) disorders has a higher rank in Iran followed by Cataract, Macular Degeneration, and Glaucoma, respectively. The ranking is the same globally and in the MENA region. There has been an increase from 1990 to 2010 in DALY attributed to eye diseases in Iran, globally, and in the MENA region with macular degeneration showing the highest increase. Cataract showed a decrease in attributed DALY from 1990 to 2010 in Iran. This pattern underscores the age-related nature of the blinding conditions and the epidemiologic transition in Iran. This is most evident in the case of macular degeneration.

The point-by-point decrease in DALY related to cataract [Graph 1] and refraction/accommodation (functional) disorders [Graph 2]
is attributable to the current treatment options of these conditions and the popularity, as well as the effectiveness of cataract surgery. The availability of phacoemulsification for wider age groups and those with systemic comorbidities play an important role in the decreased DALY for cataract in Iran.\textsuperscript{12} In fact, theoretically cataract loses its chronic disease classification because surgical care is provided as soon as it is needed. Two opposing processes, namely, epidemiologic transition and access to the sight-restorative surgery play a role in the change in DALY attributed to cataract in Iran. This may explain the observation that changes in the cataract burden are comparatively lower than other blinding conditions.\textsuperscript{12}

It is important to note that the burden of existing diseases is not merely a reflection of the prevalence, natural course, and severity of a health condition. It also is a reflection of human intervention and effort in controlling that entity. Alternately, a higher burden alone in a specific area should not result in greater resource allocation for that issue as the value that is gained may be comparatively low. Hence, there must be a judicious allocation of resources.

An interesting finding related to refraction/accommodation (functional) disorders is the bimodal nature of the curve [Graph 2], following the two broad categories of refractive errors in children and adolescents and in the middle age and older ages (presbyopia). Presbyopia affects the majority of the population over the age of 50 years\textsuperscript{13} and in the coming decades, its impact is expected to be further appreciated as near vision gains an ever-increasing functional value in the digital age. Another related development is that presbyopia is becoming a “surgical disease” in the coming decade.\textsuperscript{14}

Age-related macular degeneration (AMD) is a leading cause of irreversible vision loss in older individuals. The dramatic absolute and relative increase in the burden of macular degeneration best portrays the age-related nature of a condition that is largely untreatable. We expect that the proportion for AMD will continue to increase. This trend corresponds with other age-related health conditions such as Alzheimer’s disease.\textsuperscript{15} This increase in Iran is lower than the MENA region’s average and higher than the global average. In addition, macular degeneration ranks higher among all diseases in Iran compared to the global and the MENA averages.

The dramatic increase of the burden of glaucoma could be explained by improved diagnosis. Glaucoma has a long asymptomatic course (average 5–14 years\textsuperscript{16,17}). The other feature of glaucoma as compared with cataract is that this condition is not curable, and the therapy is lifelong. Therefore, the burden is lifelong.

A rather unexpected finding is the lack of gender disparity. Commonly, in developing countries, there is a higher rate of affliction for females. It should be noted that the four major vision-impairing entities evaluated in this study are not known to be gender-related. In fact, there is some evidence supporting a relatively higher prevalence of glaucoma and cataract among females.\textsuperscript{18,19} Alternately, the consistent higher burden of the aforementioned conditions in females in the older age groups denotes, the longer life expectancy and a greater proportion of females in those age groups.

Gender disparity in eye diseases and access to eye care services has been associated to poor visual outcomes.\textsuperscript{20} Several studies have reported the impact of economic inequality on health. The utilization of eye care services and the economic inequality might play a role in the burden of different eye conditions among age groups, between genders, among different socioeconomic groups, and in different geographical areas in the country. For example, the Shahroud eye cohort study, a population-based study in Northern Iran conducted in 2009, with 5190 respondents aged 40–64 years of age showed that 16.32% of participants had never used ophthalmic, or optometric services and 30.94% of these individuals had not done so over the past 5 years. Those with lower education, no valid insurance, lower economic status, and females seemed to have less access to eye care services.\textsuperscript{20}

The change in eye care services over the last two decades has played a role in the burden of eye diseases in Iran [Table 3]. There has been an increase in the number of ophthalmologists/optometrists in Iran over the last two decades. Additionally, there has been an increase in healthcare facilities and the percentage share of gross domestic product allocated to healthcare in Iran.

This study has some limitations. GBD 2010 includes large amounts of data on health status risk factors, but they are hardly relevant to ophthalmic conditions; hence, we could

### Table 3: The comparative best guess profile on eye services in Iran

<table>
<thead>
<tr>
<th>Phase</th>
<th>Population</th>
<th>Ophthalmologists*</th>
<th>Optometrists*</th>
<th>Phacoemulsification rate\textsuperscript{12} (%)</th>
<th>Number of eye hospitals/clinics/wards*</th>
<th>Health care share of GDP\textsuperscript{12} (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total number</td>
<td>Population adjusted per 100,000</td>
<td>Total number</td>
<td>Population adjusted per 100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>56,362,000</td>
<td>About 500</td>
<td>0.89</td>
<td>About 200</td>
<td>0.35</td>
<td>Nil</td>
</tr>
<tr>
<td>2000</td>
<td>65,911,000</td>
<td>About 900</td>
<td>1.37</td>
<td>About 1000</td>
<td>1.52</td>
<td>&lt;20</td>
</tr>
<tr>
<td>2010</td>
<td>74,462,000</td>
<td>About 1500</td>
<td>2.01</td>
<td>About 1800</td>
<td>2.42</td>
<td>&gt;95</td>
</tr>
</tbody>
</table>

\*Authors reached to these estimates through consultation with the professional societies of optometry and ophthalmology and authorities in the Ministry of Health.

Readers are best advised not to cite the very guesses. GDP: Gross domestic product.
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Conflicts of interest
There are no conflicts of interest.

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