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S-F. Mohammadi[1,2], M-R. Lashay 1, E. Ashrafi[1,3], A-A. Haghdoust[4], C. Alinia[1,3], A-R. Lashay 1, M. Asadi-Lari[5], S-M. Mohammadi[1,6,] E. Hatef[7]

توزع أطبا ء العيون وأخصائي البصريات في جمهورية إيران الإسلامية والعوامل المرتبطة بذلك

سيد فرزاد محمدي، محمد رضا لاشيى، الهام أشرفي، علي أكبر حق دوست، سيروس علي نيا، علي رضا لاشيى، محسن أسدي لاري، سيد مهرداد محمدي، الهام هاتف

الخلاصة : لقد هدفنا إلى تحديد توزع مقدمي الرعاية للعيون وعلاقة ذلك بالحالة الصحية والوضع الاجتماعي - الاقتصادي وبمؤشرات النظام الصحي . ولقد جُمعت البيانات من المجلس الطبي الإيراني والجمعيات الإيرانية لطب العيون وتصحيح البصر . وجُمعت مؤشرات متزامنة من مركز الإحصاء الإيراني ومن دراسات وطنية . واستُخدم عدد أطباء العيون وأخصائيي البصريات معاً - المصحَّح وفقاً لعدد السكان - على أنه المتغير التابع الرئيسي . كانت نسبة أخصائيي البصريات / أطباء العيون 0.9. وكان لدينا طبيب عيون واحد وأخصائي بصريات واحد لكل 40 000 و45 000 فرداً، على التوالي . ولاحظنا وجود علاقة مباشرة بين عدد أطباء العيون وأخصائيي البصريات ومتوسط العمر المتوقع على مستوى المحافظات . كما كانت هناك علاقة بين إجمالي الدخل والإنفاق في المحافظات وبين محو الأمية فيها . وكانت هناك علاقة سلبية مع معدل البطالة في المحافظات . كما كان هناك ارتباط ملحوظ بين إحصاءات المستشفيات والكثافة السكانية في المحافظات . لقد لبَّت جمهورية إيران الإسلامية نصيب الفرد الذي ترغب به منظمة الصحة العالمية من عدد أطباء العيون وأخصائيي البصريات، ولكن هناك تباين واسع في كثافتهم .

ABSTRACT We aimed to determine the distribution of ophthalmic care providers and its correlation with health and socioeconomic status and health system indicators. Data were

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gathered from the Iran Medical Council and the Iranian Societies of Ophthalmology and Optometry. Concurrent indicators were collected from the Statistical Center of Iran and national studies. A population-adjusted number of combined ophthalmologists and optometrists was used as the main dependent variable. Optometrist/ophthalmologist ratio was 0.9. We had 1 ophthalmologist and 1 optometrist for every 40 000 and 45 000 individuals, respectively. We observed a direct correlation between the number of ophthalmologists, optometrists and life expectancy at the provincial level. Gross provincial income and expenditure and provincial literacy were correlated as well. Provincial unemployment had a negative correlation. Provincial hospital statistics and population density were also significantly correlated. The Islamic Republic of Iran has met the World Health Organization's desired per capita number of ophthalmologists and optometrists, but there is wide variation in their density.

Distribution des ophtalmologues et des optométristes en République islamique d'Iran et facteurs associés

RÉSUMÉ Nous avons cherché à déterminer la distribution des dispensateurs de soins ophtalmologiques et sa corrélation avec la situation sanitaire et socio-économique ainsi qu'avec les indicateurs des systèmes de santé. Des données ont été rassemblées par le Conseil médical iranien et les Sociétés d'Ophtalmologie et d'Optométrie iraniennes. Des indicateurs concurrents ont été collectés auprès du Centre statistique d'Iran et à partir d'études nationales. Un nombre d'ophtalmologues et d'optométristes ajusté en fonction de la population a été utilisé comme principale variable dépendante. Le ratio optométriste/ophtalmologue était de 0,9. Il y avait un ophtalmologue et un optométriste pour 40 000 et 45 000 individus respectivement. Nous avons observé une corrélation directe entre le nombre d'ophtalmologues, d'optométristes et l'espérance de vie à l'échelle des provinces. Le revenu et les dépenses bruts en province ainsi que l'alphabétisation à ce niveau étaient également liés. Le chômage à l'échelle des provinces avait une corrélation négative. Les statistiques des hôpitaux de province et la densité de la population entretenaient une corrélation significative. La République islamique d'Iran a atteint le nombre d'ophtalmologues et d'optométristes par habitant fixé par l'Organisation mondiale de la Santé, mais il existe une importante variabilité dans leur densité.

[1]Eye Research Center, [2]Chams Research Chair in Public Health Ophthalmology, Farabi Eye Hospital, Tehran University of Medical Sciences, Tehran, Islamic Republic of Iran. (Correspondence to: E. Ashrafi: el.ashrafi@gmail.com). [3]Center for Non-Communicable Diseases Control, Ministry of Health and Medical Education, Tehran, Islamic Republic of Iran.
[4]
Department of Epidemiology, School of Public Health, Kerman University of Medical Sciences, Kerman, Islamic Republic of Iran.
[5]
Department of Epidemiologyand Biostatistics, School of Public Health, Iran University of Medical Sciences, Tehran, Islamic Republic of Iran.
[6]

Department of Management Sciences and Health Economics, School of Public Health, Tehran University of Medical Sciences, Tehran, Islamic Republic of Iran.
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Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, United States of America.

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Introduction

Human resources development is one of the mainstays of health system performance and national health status. As such, adequately trained human resources are one of the core components of Vision 2020: the Right to Sight initiative of the World Health Organization (WHO) and one of the main strategies for achieving universal eye health by 2020 (1,2). In a recent analysis ofeye care services and human resourcesin the Islamic Republic of Iran,using the WHOEye Care Service Assessment Tool, the number of eye care providers was a challenge.

Equitable distribution of services and resources at different levels of an eye care system is as important as the overall availability of human resources (3). In addition, the social determinants of health play a major role in the health outcomes that need attention (4). Understanding the dynamics and interactions among social factors, health outcomes and healthcare system attributes has become more important as equality in healthcare has become a main focus of the health systems (5,6).

Evidence confirms the existence of challenges in the distribution of human resources at the global as well as national level (7–9). As Resnikoff et al. illustrated, there are huge disparities among the regions and within countries (7).

In the Islamic Republic of Iran, the ophthalmologist-to-population ratio has increased by 65%

between 1979 and 2012, compared with~8% in the United States of America (USA) during the same period (10,11).

The distribution of general practitioners in the Islamic Republic of Iran has been researched (8,9), although no such study has yet provided a picture of the frequency and distribution of ophthalmologists and optometrists. In the current study, we assessed the distribution of ophthalmologists and optometrists in the Islamic Republic of Iran. We also report aggregate data on the development indices of each province in the country, its health indicators and healthcare infrastructure attributes.

Methods

This was an ecological study in which we collected aggregate data on human resources, social determinants of health, health indicators and health system infrastructure indices by province in 2013. The study protocol was approved by the Research Council of Tehran University of Medical Sciences and received partial grants from the same institute (grant number: 24422). Human resources were defined as the number of ophthalmologists and optometrists by gender and province. The number of ophthalmologists and optometrists were collected from the formal registry of physicians and allied medical care practitioners of the Iran Medical Council in 2013. We also reviewed the ophthalmologists' data in the registry of the Iranian Society of Ophthalmology and adjusted the numbers accordingly. We calculated the per capita (population-adjusted) rate of ophthalmologists and optometrists, which was obtained by dividing the number of human resources by the population of each province. We also calculated the ophthalmologist-to-optometrist ratio.

Gross household income, gross household expenditure, adult literacy, unemployment and population per province were taken as social determinants of health. Health indicators were defined as life expectancy, child mortality rate (CMR), crude death rate and crude birth rate (CBR). Health care infrastructure indices were defined as distance to the nearby metropolis, population density, number of hospitals and total number of hospital beds (number divided by population in each province). Table 1 lists the categories of variables and sources of data.

The descriptive data on the distribution of care providers, social determinants of health, health indicators and health system infrastructure indices in the country were reported. Of the 3 measures of density of ophthalmologists, population density of optometrists, and densityof ophthalmologists and optometrists combined, the latter had a normal distribution and was selected as the key measurement in evaluation of the relationship between human resources and associated factors, namely, the social determinants of health, health indicators and health care infrastructure indices. The correlation between combined rate (population-adjusted number

of combined ophthalmologists and optometrists) and the social determinants of health, health indicators and health care infrastructure indices was assessed using Pearson correlation. The data from the capital province (Tehran) were excluded from the analysis, as they were statistical outliers that were significantly different from most of the other data, which might have skewed our analysis. $P<0.05$ was considered to be statistically significant.

We assessed human resources distribution across the country by province and visualized the distribution of ophthalmologists and optometrists in the country using geographic information system maps. We exported the geographic data to ArcGIS 9.3 platform and connected it to the digital map of the provinces in the Islamic Republic of Iran using the vector format.

Results

Distribution of human resources and associated factors

The Islamic Republic of Iran has a population of > 75 million. In 2013, there were 1716 (2.29 per 100 000 population) ophthalmologists and 1919 (2.56 per 100 000 population) optometrists. The number of ophthalmologists and optometrists combined per province ranged from 11 to 1285. The number of ophthalmologists and optometrists combined per capita ranged from 1.43 to 7.19 per 100 000. There was 1 ophthalmologist and 1 optometrist for every 40 000 and 45 000 individuals at the national level, respectively.

Table 2 demonstrates the distribution of eye care providers (ophthalmologists and optometrists), in the Islamic Republic of Iran by province. Tehran and Khorasan-e-Razavi had the highest number of ophthalmologists and optometrist per capita, and the lowest rate was in Lorestan. Figure 1 presents population densities of ophthalmologists and optometrists combined (a), ophthalmologists (b) and optometrists (c) by province in 2013 in the Islamic Republic of Iran. The ophthalmologist-to-optometrist ratio across the country was < 1 (0.89), with the lowest ratio (0.17) in South Khorasan and the highest ratio in Tehran (4.32) and Isfahan (1.65). Social determinants of health, health indicators and health system infrastructure indices in the Islamic Republic of Iran are also reported in Table 2 .

Correlation between density of eye care providers and associated factors

Table 3 presents the correlation coefficients between density of ophthalmologists and optometrists combined and other care providers, social determinants of health, health indicators and health system infrastructure indices in the Islamic Republic of Iran. In terms of social determinants of health, the combined rate (population-adjusted number of combined ophthalmologists and optometrists) showed a weak positive correlation with the gross household income ($r = 0.4$, $P = 0.02$) and gross household expenditure ($r = 0.48$, $P = 0.007$). Among health indicators, the combined rate was weakly correlated with life expectancy ($r = 0.4$,

P = 0.03). In terms of health system infrastructure, the combined rate demonstrated a positive correlation with population density (r = 0.61, P <0.001), number of hospitals (r = 0.65, P <0.001) and total number of hospital beds (number divided by population in each province) (r = 0.7, P <0.001).

Discussion

The density of ophthalmologists and optometrists per 100 000 population in the Islamic republic of Iran was 2.29 and 2.56, respectively. The densities are highest among high-income countries and the Sub-Saharan African countries have the lowest rate of 0.027 per 100 000 population (7). At present, the Islamic Republic of Iran has sufficient trained eye care providers, ophthalmologists and optometrists for primary eye care (refractive) and ophthalmological services. Given the higher growth rate in the number of ophthalmologists (61% from 1979 to 2012) compared to the general population (1.9% from 1979 to 2012) in the Islamic Republic of Iran (10–12), within the next decade, we will surpass the global average and the target of 1 trained eye care provider per 50 000 population recommended by Vision 2020 (1).

The potential overlapin services provision, by optometrists and ophthalmologists, at least partly, explains the wide variation in ophthalmologist-to-optometrist ratios in the country (population-adjusted ratio of 0.14–1.05).

Tehran province has 1285 ophthalmologists and optometrists (10.7 per 100 000 population), which is higher than the rate in high-income countries (4,13). This is a consistent feature for low- and middle-income countries in which the capital cities enjoy disproportionately higher standards of living

compared with other parts of the country. In many instances, for physicians

and specialists, capital cities are the preferred place to live and settle (13). Our results indicated that the combined rate (population-adjusted number of combined ophthalmologists and optometrists) was weakly or intermediately correlated with the social determinants of health, health indicators and health system infrastructure. The correlation was positive for those provinces with high gross household income and expenditure, adult literacy as well as population density. Provinces with a high unemployment rate were negatively correlated with the combined rate. The combined rate was also negatively correlated with CMR and CBR, which might be a reflection of socioeconomic development in the country and improved health care (14,15).

The combined rate was strongly correlated with the number of hospitals and the total number of hospital beds. It might be the case that high-income provinces had more hospitals and healthcare centres or the number of beds could be representative of other health infrastructure. The population-adjusted number of beds in the Islamic Republic of Iran was 1.45 per 1000 people (145.66 per 100 000). The rate varies greatly worldwide, with 13.7 beds per 1000 people in Japan, 11.1 in Belarus, 10.3 in Republic of Korea, 8.7 in Ukraine, 8.3 in Germany, 5.9 in Cuba, 3 in the USA, 2.2 in Saudi Arabia, 1.7 in Egypt, 1.2 in Qatar and 0.4 in Afghanistan (16). A higher figure does not necessarily predict a better health status for a country. In addition, the number of hospital beds might not be a proxy for ophthalmic care development as most of the respective care nowadays is outpatient and ambulatory.

To minimize the disparities in the distribution of eye care services, there should be specific policy reforms addressing financial, physical, cultural and information access. The Islamic Republic of Iran has an established payment system for ophthalmic and surgical services. The recent health sector reform in the country lowered the co-payment for surgical services in rural referral centres to 5% and 10% for the urban governmental centres (17,18).

To improve physical access to eye care services, the geographic distance between service providers and patients, as well as the eye care provider-to-population ratio should be lowered. Health sector reform should also address the issue of specialist retention. Different financial and nonfinancial incentives were initiated to encourage specialists to stay longer in underserved areas. Another policy to address the shortage of eye care providers includes mandatory 2-year service (50% of the residency duration) for trained ophthalmologists in underserved areas.

The optometry practices are not widely distributed throughout the country. In the Islamic Republic of Iran, the practice model of optometry is not that of primary eye care, but rather, it entails a luxurious service in a well-urbanized area. One major reason is the lack of routine coverage of these services by private insurance, despite them been covered in the national insurance reimbursement system. This naturally results in the concentration of optometry practices in high-income urban areas. Compulsory coverage by the insurance companies of these services would help redistribute optometrists in the country.

The Islamic Republic of Iran has made reputable achievements in rural health status through the national health network programme, including the use of health houses and community health workers. Community health workers are local people with targeted training for primary health care (19). This solution could be applied to the primary ophthalmic care of refractive

amblyopia, nonsurgical strabismus and low vision. It could also provide a platform for ophthalmologic referral from the Houses of Health. We might need 1 optometrist for every town of 500 000 population and 1 ophthalmologist for every 3 towns (up to 150 000 population) (20).

As populations grow and life expectancy increases, the demand for eye care increases (21). Improved socioeconomic status and expanding healthcare infrastructure and technology have a similar effect. Research, industrialization and technology change disease definition, and opportunities to improve health and demand are increased accordingly. However, it is also accepted that healthcare should be vigilantly regulated. Despite recent aggressive measures to promote population growth (22), it is unlikely that this will catch up with the growth in the number of eye care providers. The dramatic increase in the number of trained eye care providers will result in some redistribution throughout the country, in return, improving access to services. However, it will not be a creative or full solution to inequality in their distribution. Such over-supply is known to increase demand, for example, earlier and unnecessary cataract surgery in urban areas (23).

This study had some limitations. The associations observed at the provincial level will not necessarily hold at the individual level. This is a limitation in ecological studiesthat especially limits inferential and explanatory aspects. Provincial level aggregated data were available, but exploring disparity of human resources distribution among large cities was not feasible. More accurate assessments of human resources distribution require details about the distribution of public and private eye care providers, supplementary insurance coverage and even the local prevalence of eye diseases. Data related to other eye care providers such as ophthalmic nurses and ophthalmic medical assistants were not available to the researchers, and they were excluded from the analyses.

In conclusion, with respect to absolute figures, the Islamic Republic of Iran has enough ophthalmologists and optometrists as recommended by the WHO. Extreme disparity exists at 2 different levels. About 35% of all ophthalmologists and optometrists in the country (1285 of 3635) practice in the province of Tehran, and excluding the capital, there is still a broad variation in the density of ophthalmologists and optometrists in the country. The distribution is correlated with the social determinants of health, health indicators and health system infrastructure indices. It is necessary to assess the required number of ophthalmologists and optometrists in the Islamic Republic of Iran for the next decade. More ophthalmology residency vacancies should be assigned to underserved areas. Optometrists' role should be redefined for primary eye care in rural regions and small towns; preferential reimbursements policies seem instrumental. Allocation of optometry training positions to local people in underserved areas with predefined employment arrangements is recommended.

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