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Prevalence and Risk Factors of Refractive Errors and Effective Spectacle Coverage in Emiratis and Non-Emiratis Aged 40 Years or Older: the Dubai Eye Health Survey

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Purpose: The aim was to investigate the prevalence and risk factors of refractive errors (REs) and the effective spectacle coverage in Emiratis and non-Emiratis in Dubai.

Design: The Dubai Eye Health Survey was a population-based cross-sectional study of participants aged 40 years or older.

Methods: Distance and near visual acuity (VA), and noncycloplegic automated refraction were tested according to a standardized protocol. Distance VA was tested using the Early Treatment Diabetic Retinopathy Study (ETDRS) logMAR chart at 3 m and near VA was measured using the near vision logMAR chart at 40 cm under ambient lighting. Myopia was defined as spherical equivalent of refraction of less than –0.50 diopters (D), and hypermetropia as spherical equivalent of more than +0.50 D. Astigmatism was defined as cylinder power of 0.5 D or greater. Effective spectacle coverage for distance vision was computed as met need/(met need+unmet need+under-met need)×100%. Multivariable logistic regression models were used to examine associations between sociodemographic factors and RE.

Results: The authors included 892 participants (446 Emiratis and 446 non-Emiratis) in the analysis. The prevalence of hypermetropia was 20.4% [95% confidence interval (CI): 16.8%–24.4%] in Emiratis and 20.6% (95% CI: 20.0%–24.7%) in non-Emiratis. The prevalence of myopia and high myopia was 27.4% (95% CI: 23.3%–31.7%) and 1.8% (95% CI: 0.8%–3.5%) in Emiratis, and 19.5% (95% CI: 15.9%–23.5%) and 0.9% (95% CI: 0.2%–2.3%) in non-Emiratis, respectively. High education ($P=0.02$) and not currently working ($P=0.002$) were risk factors of myopia in non-Emiratis only. The prevalence of astigmatism was 7.4% (95% CI: 5.1%–10.2%) in Emiratis and 1.6% (95% CI: 0.6%–3.2%) in non-Emiratis. This prevalence was higher in individuals aged over 60 years ($P<0.001$) and men ($P=0.014$) among Emiratis. The prevalence of anisometropia and uncorrected presbyopia was 11.4% (95% CI: 8.6%–14.8%) and 0.7% (95% CI: 0.1%–2.0%) in Emiratis, and 9.2% (95% CI: 6.7%–12.3%) and 0.4% (95% CI: 0.05%–1.6%) in non-Emiratis, respectively. The effective spectacle coverage was 62.3% (95% CI: 54.0%–70.6%) and 69% (95% CI: 60.5%–77.5%) in Emiratis and non-Emiratis, respectively.

Conclusions: A high proportion of Emiratis and non-Emiratis was affected by RE without optimal effective spectacle coverage, highlighting the imperativeness of intervention to alleviate the burden. The findings may help facilitate evidence-based policymaking concerning the delivery of eye care services and allocation of medical resources in Dubai.

Key Words: Dubai, Emiratis, epidemiology, non-Emiratis, prevalence, refractive error, risk factors

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INTRODUCTION

Refractive errors (REs) refer to a series of abnormal refractive conditions including hypermetropia, myopia, astigmatism, and presbyopia, which are mainly caused by the mismatch between the axial length and refractive power of the eye.[1] Uncorrected RE was the major cause of moderate and severe visual impairment and the fourth leading cause of blindness in 2020, accounting for approximately 86.1 million (41%) of moderate and severe visual impairment and 2.3 million (6.6%) of blindness cases worldwide.[2] RE undermines the quality of life[3] and its high prevalence imposes a heavy economic burden.[4–6] With the rapid growth of the aging population, it is imperative to minimize the burden of uncorrected RE.[2]

Although RE has been recognized as a serious public health problem, there has been no epidemiological survey of RE in Dubai as well as the United Arab Emirates (UAE) as a whole. Several studies have investigated the prevalence of RE in neighboring countries of the Middle East region, but most of them focused on children and adolescents instead of middle-aged and older adults.[7] The paucity of population-based data has been identified as the major challenge for eye care in the Emirate according to a recent domestic assessment. To effectively promote the intervention for RE risk reduction, it is of great importance to scientifically and accurately measure the prevalence of RE and determine the associated risk factors in Dubai Emiratis. The demographic structure and possibly disease patterns between the Emiratis (the UAE nationals) and non-Emiratis (the non-UAE national residents) are different. Meanwhile, a higher prevalence of diabetes and other chronic diseases has been observed in Emiratis than in non-Emiratis.[8,9] Therefore, it is of great interest to test the differences in the distribution of RE between Emiratis and non-Emiratis.

Consequently, a Dubai Eye Health Survey was carried out to collect population-level data regarding the burden, distribution, and associated factors of RE and estimate the effective spectacle coverage. The survey will contribute to the advancement of universal eye health coverage among Emiratis and non-Emiratis, generate relevant information on the development of Dubai strategic plan for eye care and rehabilitation services, and guide eye care service delivery and medical resource allocation that can improve the health and quality of life of the population.

METHODS

Study Participants

The Dubai Eye Health Survey was a population-based cross-sectional survey of residents in Dubai. It was conducted over 3 months beginning in December 2019 and abruptly terminated due to the outbreak of the coronavirus disease 2019 (COVID-19) pandemic. The main purpose of the study was to investigate the magnitude and causes of visual impairment and RE amongst persons aged 40 years or older in this region. This age group of participants was selected because a previous study has shown that the risk of RE increased by 1.8 times for each 10 years of life starting at 40 years of age.[10]

Participants were randomly selected from the household database of Dubai residents by the Dubai Statistics Center (DSC). The target populations were Emiratis and non-Emiratis. All Dubai residents aged 40 years or older who had lived in the selected households during the last 6 months or would be living in the households for the next 6 months were included. Visitors to Dubai who had not or would not stay for 6 months or more were excluded. The original sample size for the survey was calculated and allocated to each stratum (Emiratis and non-Emiratis) according to the proportion of people aged 40 years or older and the assumed proportion of visual impairment as reported by the 2018 Dubai Disability Survey. Based on the probability proportional to size, stratified cluster sampling was used to randomly select 165 clusters across the population strata. The sample size was calculated using the following formula:

$$N = \frac{Z^2 \times p \times q \times deff}{e^2 \times RR}$$

where: $Z = 1.96$ [statistics from standard normal distribution for 95% confidence level (CI)], $p = 0.05$ (proportion of VI in Dubai population aged 40 years or older, according to Disability Survey in Dubai, 2018), $q = 1–p = 0.95$, deff = 1.5 (design effect for cluster survey), RR (response rate) = 0.80, and e (margin of error) = 0.0125. The average size of each cluster is 13. In each cluster, individuals were randomly selected from the general people through the household database of the DSC, and they were contacted by phone and invited to visit the health center for the study.

Selected individuals were contacted through phone and asked to participate in the survey by visiting the nearest of the 4 survey centers located in the ophthalmic units of some primary health centers and private clinics. This study adhered to the Declaration of Helsinki and was approved by the Dubai Scientific Research Ethics Committee of the Dubai Health Authority (DSREC-05/2019_03). Each participant provided written informed consent.

Procedures

General demographic information, including age, gender, nationality, educational level, working status, as well as medical and ocular history (including the history of diabetes mellitus), were collected by trained nurses. Uncorrected, presenting, and best-corrected distance visual acuity (VA) was tested for all participants using the Early Treatment Diabetic Retinopathy Study (ETDRS) logMAR chart (Tumbling E Series ETDRS Chart 1; Precision vision, La Salle, US) at 3 m under ambient lighting. Distance VA was measured monocularly and binocularly, and recorded as the smallest line in which the correct orientation of at least 3 of the 4 characters could be identified. Participants with spectacles or contact lenses were asked to remove them first and then wear them for repeat testing. If a participant could not see any letter, VA was subsequently assessed through counting finger at 1 m, down to light perception. Near VA was also tested for all participants, and each participant was asked if he/she was using reading glasses or bifocal/progressive lenses before the testing. Near VA was measured binocularly with and without available optical correction using the near vision logMAR chart at 40 cm under ambient lighting. Multilingual reading charts were used and the Vocational Near Vision Test Type (Clement Clarke International Ltd) was used for the English version. All VA measurements were conducted by optometrists with 1 in each survey center. During the training session before the commencement of the study, the interobserver variability for VA assessment was required to achieve a high agreement (kappa = 0.8). Besides, noncycloplegic automated refraction was performed by the optometrists using the Topcon KR1 autorefractometer (Topcon, Tokyo, Japan). Following the autorefraction measurement, participants with <6/12 unaided VA in any eye received subjective refraction measurement. Further, participants for whom automated refraction could not be obtained due to media opacities also received subjective refraction. All participants had random blood sugars tested through a point-of-care BioHermes hemoglobin A1c (HbA1c) device (BioHermes, Jiangsu, China).

Definition of RE

Refractive status was determined based on the average of 3 consecutive noncycloplegic autorefraction measurements. Spherical equivalent (SE) was calculated as spherical power plus half of the cylindrical power. The eye with the greater absolute value of SE was used to define RE. Myopia was defined as SE of less than –0.50 diopters (D), hypermetropia as SE of more than +0.50 D, and emmetropia as SE between –0.5 and +0.50 D. SE of less than –5 D was defined as high myopia. Astigmatism was defined as cylinder power of 0.5 D or greater, and anisometropia was defined as an interocular difference of 1.0 D or more in SE. Uncorrected presbyopia was defined as the inability to read the N6 line binocularly on the near vision chart at 40 cm using available correction, but with a distance corrected vision of 6/12 or better in either eye. These conditions were defined using the methods from previous studies.[11–13]

Effective spectacle coverage (often interchangeably used with effective refractive error coverage, eREC) for distance vision was computed by met need/(met need+unmet need +under-met need)×100%.[14] Met need was defined as participants who had uncorrected distance vision of <6/12 but the presenting vision of 6/12 or more with glasses. Unmet need was defined as participants who were not using glasses and had an uncorrected vision of <6/12 but corrected vision of 6/12 or more. The under-met need was defined as participants with uncorrected vision of <6/12 and the presenting vision of <6/12 with glasses, but with the corrected vision of 6/12 or more.

Statistical Analysis

All data were entered into a digital record form specifically designed for this survey, with checking systems. Daily fieldwork data were downloaded and reviewed by the survey supervisors to check potential errors. Statistical analyses were performed using SAS 9.4 for Windows (SAS Institute Inc). Age-adjusted and gender-adjusted prevalence of RE was estimated based on population census data (PROC SURVEYLOGISTIC). The prevalence of RE was reported separately for Emiratis and non-Emiratis. Participants were divided into 3 age groups (40–49, 50–59, and 60 years or older) and 3 educational groups: the illiterate group, lower secondary/post-secondary group, and bachelor/masters/doctoral group, corresponding to low, moderate, and high educational level. Participants in paid employment are classified as "Currently Working," while those that are retired, unemployed, or on unpaid duties are classified "Not Working." Participants with diabetes mellitus history or HbA1c of 6.5% or greater were considered diabetic. χ^2 for categorical variables and t test for continuous variables were used to test differences in sociodemographic characteristics between Emiratis and non-Emiratis. Multivariable logistic regression models were used to access the association between RE and potential risk factors for Emiratis and non-Emiratis. A P value of <0.05 was considered statistically significant.

RESULTS

In total, 2150 residents in 165 clusters were eligible to participate in the study but only 1065 (49.5%) in 71 clusters were enumerated from the registry due to the onset of the COVID-19 pandemic. Of these, 895 participants underwent examinations, resulting in a relatively low overall response rate of 41.6% (895/2150). A total of 895 (42%) participants were examined in the survey. After excluding participants with missing data on RE, 892 participants (mean ± SD of age: 52.25 ± 9.63 years; 56.1% male) were included in the current analysis, including 446 Emiratis (50%) and 446 non-Emiratis (50%).

The demographic characteristics of the Emirati and non-Emirati participants were summarized in Table 1. Compared with Emiratis, non-Emiratis were significantly younger (54.72 vs 49.73 years, $P<0.001$) with a larger proportion of males (45.1% vs 67.4%, $P<0.001$) and more likely to be current workers (41.5% vs 64.1%, $P<0.001$). The percentage of diabetes (29.8% vs 15.0%, $P<0.001$) was significantly higher in Emiratis than non-Emiratis.

Figure 1 illustrates the distribution of SE RE in terms of the right and left eyes of the Emirati and non-Emirati participants. The mean SE of the study population was –0.15 D ± 1.86 (SD) and –0.16 D ± 2.00 (SD) for right and left eyes, respectively. The

TABLE 1. Sociodemographic Characteristics in Emiratis and non-Emiratis in Dubai Emirate

	Total	Emiratis	Non-Emiratis	*P* value*
Age (y)	52.09 ± 9.48	54.45 ± 9.56	49.73 ± 8.80	< 0.0001
Gender				< 0.0001
Female	394 (44.2)	245 (54.9)	149 (33.4)	
Male	498 (55.8)	201 (45.1)	297 (66.6)	
Education				0.42
Low	205 (23.0)	105 (23.5)	100 (22.4)	
Moderate	492 (55.2)	249 (55.8)	243 (54.5)	
High	195 (21.9)	92 (20.6)	103 (23.1)	
Diabetes				< 0.0001
No	632 (70.9)	285 (63.9)	347 (77.8)	
Yes	260 (29.1)	161 (36.1)	99 (22.2)	
Working status				< 0.0001
Currently working	474 (53.1)	185 (41.5)	289 (64.8)	
Not working	418 (46.9)	261 (58.5)	157 (35.2)	

*t test for continuous variables and χ^2 test for categorical variables were used to test the difference in characteristics between Emiratis and non-Emiratis.

prevalence of RE was 58.3% (95% CI: 54.9%–61.7%) in the whole population with a higher prevalence [63.1% (95% CI: 58.5%–67.7%)] in Emiratis than in non-Emiratis [52.8% (95% CI: 47.8%–57.8%), $P = 0.0032$]. The details of the distribution of RE by strata were listed in Table 2. The overall prevalence of hypermetropia, myopia, astigmatism, and uncorrected presbyopia was 16.2% (95% CI: 13.8%–18.5%), 25.3% (95% CI: 22.2%–28.4%), 3.2% (95% CI: 2.1%–4.2%), and 0.6% (95% CI: 0.0%–1.2%), respectively. Moreover, the prevalence of myopia [30.6% (95% CI: 25.9%–35.3%) vs 20.7% (95% CI: 16.7%–24.6%), $P = 0.0017$], and astigmatism [5.6% (95% CI: 3.6%–7.7%) vs 1.0% (95% CI: 0.2%–1.8%), $P = 0.0001$] were

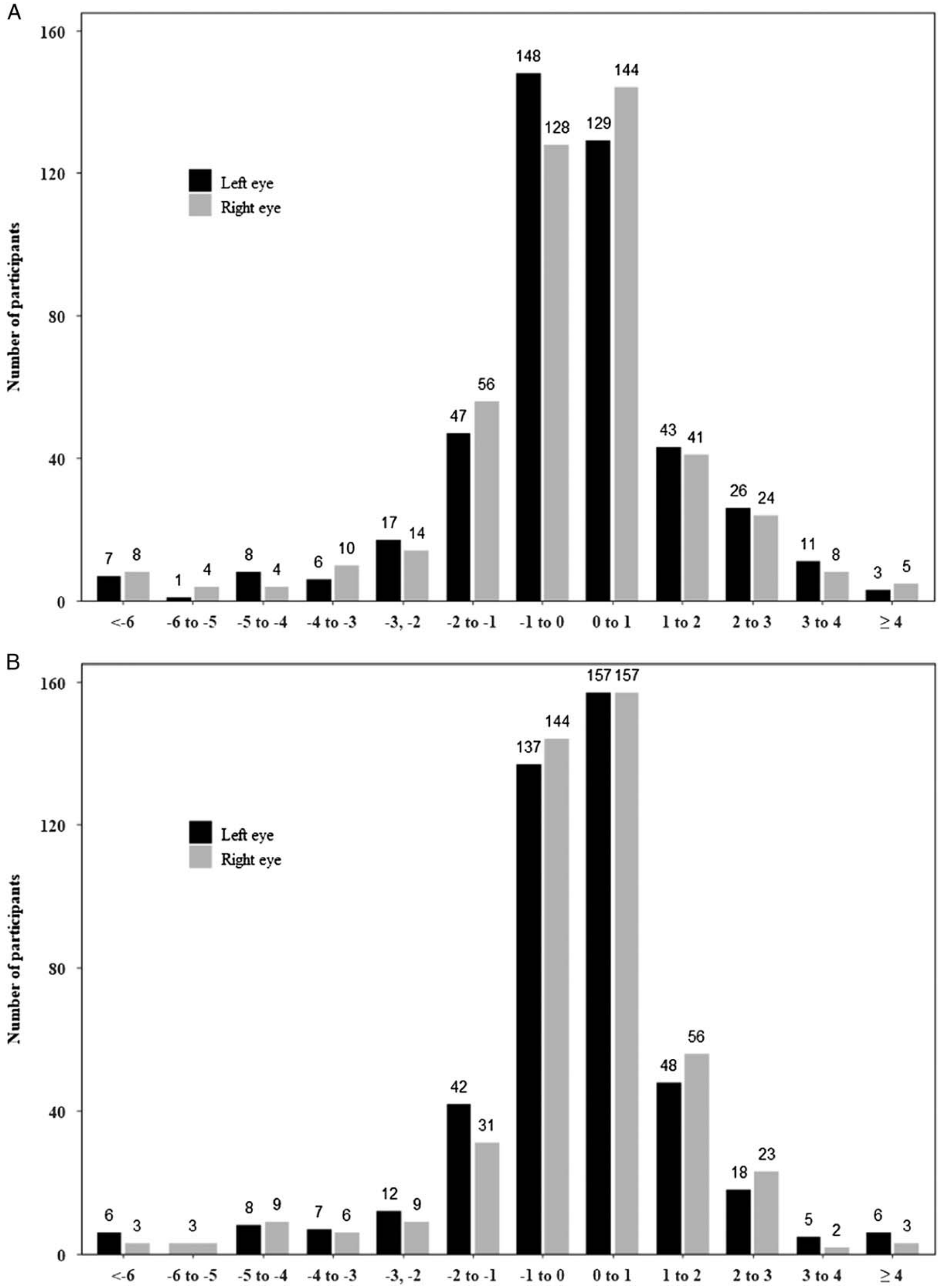

FIGURE 1. Distribution of spherical equivalent in the right and left eyes of Emiratis (A) and non-Emiratis (B).

TABLE 2. Prevalence of Refractive Errors in Emiratis and Non-Emiratis in Dubai Emirate

	Total		Emiratis		Non-Emiratis		
Refractive Error	**No.**	**Weighted Prevalence†**	**No.**	**Weighted Prevalence**	**No.**	**Weighted Prevalence**	***P* value***
Emmetropia	381	45.8 (42.3–49.3)	176	41.4 (36.5–46.3)	205	49.6 (44.7–54.5)	0.0214
Hypermetropia	183	16.2 (13.8–18.5)	91	16.1 (12.7–19.4)	92	16.2 (12.9–19.5)	0.95
Low Myopia	209	25.3 (22.2–28.4)	122	30.6 (25.9–35.3)	87	20.7 (16.7–24.6)	0.0017
High Myopia	12	1.5 (0.6–2.3)	8	2.0 (0.5–3.4)	4	1.0 (0.0–2.0)	0.30
Astigmatism	40	3.2 (2.1–4.2)	33	5.6 (3.6–7.7)	7	1.0 (0.2–1.8)	0.0001
Presbyopia (uncorrected)	5	0.6 (0.0–1.2)	3	0.7 (0.0–1.6)	2	0.6 (0.0–1.3)	0.80

*χ^2 test was used to examine the difference in prevalence of refractive errors between Emiratis and non-Emiratis.

†Age-adjusted and gender-adjusted prevalence was estimated based on population census data (PROC SURVEYLOGISTIC).

significantly higher in Emiratis than in non-Emiratis. There was no difference in the prevalence of hypermetropia, high myopia, and uncorrected presbyopia between Emiratis and non-Emiratis. The distribution of hypermetropia, emmetropia, myopia, and astigmatism by gender, age groups, and Emiratis/non-Emiratis is shown in Figure 2.

The effective spectacle coverage for distance vision was 60.3% (95% CI: 51.6%–69.1%) in Emiratis [men: 67.2% (95% CI: 55.0%–79.5%), women: 53.9% (95% CI: 41.5%–66.3%)] and 68.7% (95% CI: 59.9%–77.5%) in non-Emiratis [men: 76.6% (95% CI: 66.2%–87.0%), women: 55.3% (95% CI: 40.0%–70.5%)]. There was no significant difference in the coverage between the Emiratis and non-Emiratis ($P=0.19$). The prevalence of RE by age, gender, and educational level in Emiratis and non-Emiratis is shown in Supplementary Digital Content Table 1, http://links.lww.com/APJO/A180 and Table 2, http://links.lww.com/APJO/A181. The corresponding results of multivariable logistic regression analysis are shown in Tables 3 and 4. The risk of hypermetropia significantly increased with age in both Emiratis [50–59 vs 40–49 years: odds ratio (OR): 7.60, 95% CI: 2.42–23.85; >60 vs 40–49 years: OR: 13.59, 95% CI: 4.10–44.99] and non-Emiratis (50–59 vs 40–49 years: OR: 66.73, 95% CI: 20.04–222.1; >60 vs 40–49 years: OR: 40.25, 95% CI: 10.63–152.4). No significant association was found between hypermetropia and gender, education levels, working status, or diabetes. A high education level (high vs low education: OR: 2.58, 95% CI: 1.20–5.54) and currently not working (other vs currently working: OR: 2.49, 95% CI: 1.39–4.46) were associated

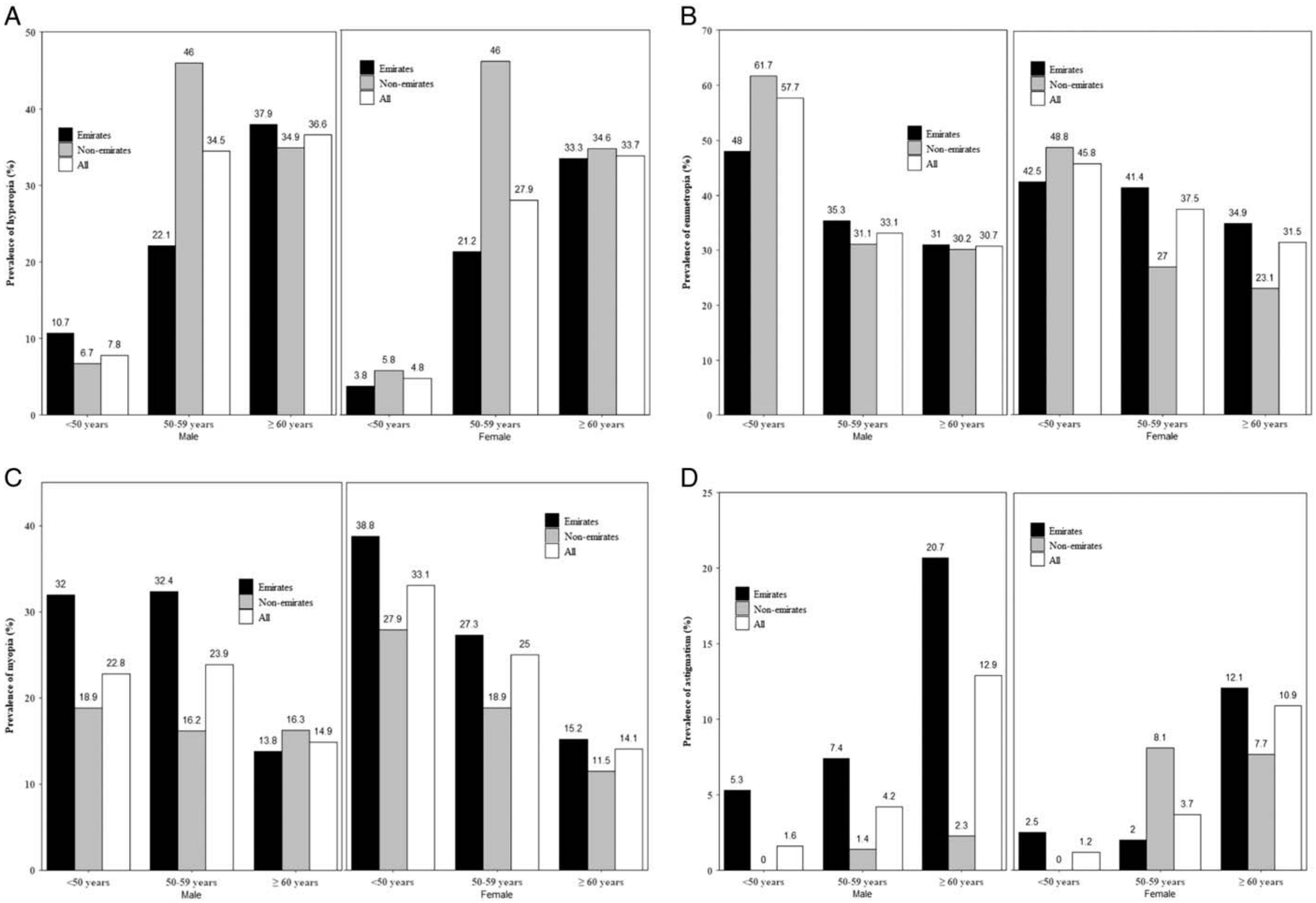

FIGURE 2. Prevalence of refractive errors by gender and age in Emiratis and non-Emiratis. A–D refer to the prevalence of hypermetropia, emmetropia, myopia, and astigmatism, respectively.

TABLE 3. Multivariate Logistic Regression Analysis of Risk Factors for Hypermetropia, Myopia, High Myopia, and Astigmatism Among Emiratis

	Hypermetropia			Myopia			High myopia			Astigmatism		
Variable	**OR***	**95% CI**	***P***	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***
Age, y												
40–49	Ref			Ref			Ref			Ref		
50–59	7.6	(2.42–23.85)	< 0.001	0.89	(0.31–2.58)	0.72	0.89	(0.31–2.58)	0.72	2.36	(0.29–18.94)	0.54
60+	13.59	(4.10–44.99)	< 0.001	0.8	(0.24–2.65)	0.83	0.8	(0.24–2.65)	0.83	15.98	(3.15–81.06)	< 0.001
Gender												
Female	Ref			Ref			Ref			Ref		
Male	1.29	(0.78–2.14)	0.32	0.97	(0.63–1.51)	0.9	0.97	(0.63–1.51)	0.9	2.77	(1.23–6.22)	0.0137
Education level												
Low	Ref			Ref			Ref			Ref		
Moderate	0.96	(0.55–1.65)	0.78	0.78	(0.43–1.42)	0.65	2.54	(0.26–24.84)	0.29	0.74	(0.30–1.82)	0.76
High	0.51	(0.24–1.08)	0.19	1.14	(0.57–2.27)	0.84	1.19	(0.06–22.38)	0.43	0.64	(0.19–2.16)	0.61
Working status												
Currently working	Ref			Ref			Ref			Ref		
Not working	1.23	(0.65–2.33)	0.78	0.91	(0.54–1.55)	0.73	0.12	(0.01–1.05)	0.0552	1.22	(0.46–3.22)	0.69
Diabetes												
No	Ref			Ref			Ref			Ref		
Yes	0.7	(0.41–1.20)	0.52	1.36	(0.83–2.23)	0.23	1.21	(0.25–5.76)	0.81	0.81	(0.36–1.81)	0.61

*All other factors were adjusted for in the analysis for each risk factor.

CI indicates confidence interval; OR, odds ratio.

with a higher likelihood of myopia only in non-Emiratis. In addition, participants aged over 60 years had a higher risk of astigmatism than those aged 40 to 49 years (OR: 15.98, 95% CI: 3.15–81.06), and men had a higher risk of astigmatism than women (OR: 2.77, 95% CI: 1.23–6.22) among Emiratis.

DISCUSSION

This study fills the gap in the population-based data on the prevalence and risk factors of RE and the effective spectacle coverage amongst Emiratis and non-Emiratis in Dubai. Significant RE was commonly seen among Dubai residents aged 40 years or older, with around 60.5% of Emiratis and 54.0% of non-Emiratis affected. Emiratis were more likely to suffer from myopia, astigmatism, and anisometropia than non-Emiratis. The risk of hypermetropia significantly increased with age in both Emiratis and non-Emiratis. High education level and unemployment were identified to be the risk factors for myopia only in non-Emiratis. Participants aged over 60 years and men had a higher risk of astigmatism among Emiratis. The effective spectacle coverage for distance vision was 62.3% and 69.0% among Emiratis and non-Emiratis, respectively. The results highlight the necessity for intervention to alleviate the burden of RE and facilitate future evidence-based policymaking related to the delivery of eye care services.

Several studies have reported the prevalence of RE in the Middle East,[15–17] however, the population of these studies was mainly young (infants or university students) or older individuals

TABLE 4. Multivariate Logistic Regression Analysis of Risk Factors for Hypermetropia, Myopia, High Myopia, and Astigmatism Among Non-Emiratis

	Hypermetropia			Myopia			Astigmatism*		
Variable	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***	**OR**	**95% CI**	***P***
Age, y									
40–49	Ref			Ref					
50–59	66.73	(20.04–222.1)	< 0.001	0.54	(0.12–2.53)	0.21			
60+	40.25	(10.63–152.4)	< 0.001	0.75	(0.14–3.93)	0.98			
Gender									
Female	Ref			Ref			Ref		
Male	1.03	(0.59–1.80)	0.92	0.74	(0.45–1.21)	0.23	0.19	(0.03–1.03)	0.0538
Education level									
Low	Ref			Ref			Ref		
Moderate	1.37	(0.68–2.75)	0.4	1.88	(0.95–3.75)	0.0745	1.64	(0.16–16.73)	0.83
High	1.31	(0.59–2.92)	0.51	2.58	(1.20–5.54)	0.0209	1.77	(0.14–22.54)	0.64
Working status									
Currently working	Ref			Ref			Ref		
Not working	0.81	(0.42–1.56)	0.53	2.49	(1.39–4.46)	0.0021	0.32	(0.05–2.19)	0.25
Diabetes									
No	Ref			Ref			Ref		
Yes	0.79	(0.41–1.54)	0.49	1.34	(0.72–2.52)	0.36	0.73	(0.11–4.74)	0.67

*Empty cells have no appropriate odds ratios due to the small number of events. All other factors were adjusted for in the analysis for each risk factor.

CI indicates confidence interval; OR, odds ratio.

aged 60 years or above. Notably, our study included middle-aged adults aged 40 years or older in the analysis. To our knowledge, this study is the first epidemiological survey of RE conducted in Dubai as well as the whole UAE. There are very limited studies of RE in adults from the countries of the Gulf region, which shares similar demographic structure and disease patterns with Dubai. Based on our findings, the prevalence of RE among Emiratis aged 40 years or older in Dubai (hypermetropia: 20.4%, myopia: 27.4%, and astigmatism: 7.4%) was similar to a study in northern Saudi Arabia (hypermetropia: 11.9%, myopia: 24.4%, and astigmatism: 9.5%),[18] but it was lower than that reported in several population-based studies of the adult population, including a study in neighboring Iran-Yazd Eye Study (hypermetropia: 20.6%, myopia: 36.5%, astigmatism: 53.8%),[19] the Singapore epidemiology of eye disease study (hypermetropia: 31.5%, myopia: 38.9%, astigmatism: 58.8%),[13] the Chinese American Eye Study (hypermetropia: 40.2%, myopia: 35.1%, astigmatism: 45.6%).[12] The US National Health and Nutrition Examination Survey (hypermetropia: 3.6%, myopia: 33.1%, astigmatism: 36.2%)[20] and the Myanmar-Meiktila Eye Study (hypermetropia: 15%, myopia: 42.7%, astigmatism: 30.6%)[21] reported a relatively low prevalence of hypermetropia, probably because of a more restricted definition of hypermetropia. The prevalence of uncorrected presbyopia was much lower in Dubai than that reported in other regions (>20%).[22] This could mainly be due to the demography of the study population, with over 70% of the population in the Dubai Eye Health Survey younger than 60 years. In addition, the prevalence of myopia, astigmatism, and anisometropia was significantly lower in non-Emiratis than Emiratis. This could be owing to the demography of the non-Emiratis who are mainly composed of healthy younger males because most of them are mainly professional expatriates and South Asian laborers. Considering the unique population structure of Dubai where only 15% of the population are nationals, there were still many deficiencies in the delivery of required eye care services in the Emirati community.

Consistent with previous studies,[22–26] prevalence of hypermetropia increased with aging. This could be explained by the hyperopic shift caused by decreased lens refractive power, flattened corneal curvature as well as displacements of the lens with age. Myopia was positively correlated with education level in the current study and previous large cohort studies,[27–29] which could be attributed to the reduction of time spent outdoors with increasing educational pressures.[30,31] Recent mendelian randomization studies showed that every additional year of education was associated with a more myopic RE of 0.27 D per year.[32] Non-Emiratis without occupations were supposed to have a relatively low socioeconomic status because they lack steady resources of income. They were less prone to pay for the eye care service and spectacles, resulting in the development of myopia. In our study, astigmatism with cylinder power >0.5 D was more prevalent in the elderly over 60 years of age mong Emiratis. A similar trend of increasing astigmatism with age was also observed in several studies,[25,33,34] highlighting the role of age as a risk factor for astigmatism. However, the underlying mechanism for the gender difference remained unclear.

Although the prevalence of eREC in our study was higher than reported in Pakistan (15.1%),[35] a state of India (37.4%),[36] and South Africa (51.4%),[35] it was lower than that of the indigenous Australians (82.2%). However, our study did not record persons using contact lenses or those who had had refractive surgery; this might have underestimated the prevalence eREC in our study.

Recent United Nations (UN)[37] and World Health Organization (WHO)[38] resolutions have both identified eREC as one of the monitoring tools to measure the contribution of eye care to universal health coverage and the UN 2030 Sustainable Development Goals. The WHO resolution had set up the global targets for eREC for each country to be a 40% of increase in effective coverage of RE by 2030. With eREC of at least 60% in Dubai, achieving the WHO target will result in 100% universal coverage in the Emiratis. Uncorrected RE is an important cause of vision impairment and is easily corrected by spectacles.[2] Based on the fact that uncorrected RE has become the leading cause of vision impairment, it is estimated by WHO that over 800 million people have distance or near vision impairment that could be addressed with an appropriate pair of spectacles.[39] Given the high prevalence of RE in Dubai and suboptimal eREC, the strategic development to improve refractive care accessibility in Dubai is necessary to treat avoidable vision impairment. Government and public health agencies should therefore ensure the delivery of comprehensive and available eye care to the community and expand the coverage of high-quality optometric services and affordable spectacles. The population at higher risk of RE, including men, the elderly, and those unemployed, need to receive more attention.

The strengths of this study include the population-based survey on RE among adults in the UAE, and the use of the validated methodology of stratified cluster sampling ensured equal sampling of Dubai residents from different population groups. Standardized protocols were used by trained ophthalmologists, optometrists, and nurses to carry out the examinations. Besides, the study reports comprehensive and nationally representative data on the prevalence of different types of RE in Dubai. Several limitations of this current study should be noted. First, the low response rate of 41.6% (895/2150) could lead to bias in the estimates of RE prevalence, which may limit the generalizability of our findings. It was attributed to the abrupt termination of the survey due to the outbreak of the COVID-19 pandemic. In addition, the lack of compliance of participants to attend the eye examination also contributed to a lower response rate. However, a comparison between participants and nonparticipants showed no significant demographic difference, suggesting this problem was more likely to affect the estimation of prevalence rather than biasing the sample characteristics. Second, only a limited number of risk factors were assessed in our study mainly because of the difficulty in the complete collection of health information. Further exploration of more potential risk factors is needed. In addition, RE was determined by noncycloplegic automated refraction in our study. Nevertheless, the study population was aged over 40 years old and excessive residual accommodation should not be a problem. Thirdly, given the relatively small sample sizes in the subgroups of some variables, the estimated confidence intervals for hypermetropia risk are too wide.

In conclusion, this study presents population-based data on the prevalence, risk factors of RE, and effective spectacle coverage among Emiratis and non-Emiratis in Dubai.

Significant REs were commonly seen among both Emiratis and non-Emiratis with less-than-optimal effective spectacle coverage. Our results will play a pivotal role in establishing an effective strategy for addressing RE to reduce the visual morbidity due to RE in Dubai. Further efforts are required to improve access to quality RE services and glasses, especially of those disproportionally affected by RE including men, the elderly, and those unemployed. An affordable wider range of health insurance for optical services may assist in achieving this. To reduce the nonresponse rate in future studies in Dubai, home visits should be considered for participants who would not come to the health center for the study. Moreover, future studies in this field may include the measurement of effective spectacle coverage for near vision.

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