The Prevalence and Determinants of Pterygium and Pinguecula in an Urban Population in Shahroud, Iran

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Abstract- While pterygium is considered a common eye disorder, the etiology and pathogenesis is still not known. The aim of this study was to describe the prevalence of pterygium and pinguecula in the over 40 population of Shahroud and assess associated factors. The present study is part of the phase one of the Shahroud Eye Cohort Study conducted in 2009, in which the target population was people between 40 and 64 years of age. Ophthalmic examinations were performed by two ophthalmologists who made the diagnosis of pterygium and pinguecula. We used Chi-square tests, analysis of variance, and multiple logistic regression tests to examine associations. Of the 6311 invitees, 5190 people participated in the study (response rate: 82.2%). The prevalence of pterygium in at least one eye was 9.4% (95% CI, 8.6-10.3), while 2.9% (95%CI, 2.4-3.3) had bilateral pterygium. The prevalence was significantly higher in men (11.4% vs. 8.0%), and remained relatively constant with age, while the prevalence in women significantly increased with age. The prevalence of pinguecula was 61.0% (95%CI, 59.1-62.9) in at least one eye, and 49.0% (95%CI, 47.1-50.9) in both eyes. The age difference between those with and without pinguecula was significant and the prevalence was significantly higher among men than women (70.6% vs. 53.8%). The prevalence of pterygium in our study was lower than reported rates in the world but higher than Tehran and was significantly associated with age, gender, working outdoors, and the level of education. The prevalence of unilateral and bilateral pinguecula falls in the mid range and was significantly associated with age, male gender, smoking, working outdoors, and level of education.

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Keywords: Pinguecula; Population study; Prevalence; Pterygium; Shahroud

Introduction

Pterygium is a fibrovascular overgrowth of conjunctiva onto the cornea. While it is considered a common eye disorder, the etiology and pathogenesis is still not known (1-4). Pinguecula is histologically similar to pterygium, but it spares the cornea (1,5,6). In advanced cases of pterygium, visual function is impaired due to reduced corneal transparency in the papillary area, and increased regular and irregular corneal astigmatism (6). A number of studies have been conducted around the world to demonstrate the prevalence of pterygium and its risk factors; prevalence rates of unilateral cases range from 0.3% to 37.1% (6-31). However, studies on pinguecula are not many, and its prevalence has been reported in few studies giving rates of unilateral cases from 41.0% to 90.0% (8,16,17,24). Different factors such as age, (6,8,9,11,12,14-19,23) gender, (6-9,11,12,15-18,20) working outdoors, (6,7,19,32-35) and educational level (10-12,14) have been recognized as risk factors for

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pterygium, although debate exists in terms of some factors. Other environmental factors such as dust and dry air have been studied as risk factors for pterygium (36). In Iran, the only report on the prevalence of pterygium and pinguecula was done in 2002 on the population of Tehran; the prevalence of unilateral pterygium and pinguecula was 1.3% and 22.5%, respectively. Age, gender, and smoking were associated with pterygium, while pinguecula was associated with age, gender, and ethnicity (8).

The present study is a population based conducted in Shahroud, Iran. Hereby, we present the prevalence of pterygium and pinguecula, and their associations with some factors.

Materials and Methods

The present report concerns part of the first phase of the Shahroud Eye Cohort Study (37) conducted in 2009. The target population of the study was the 40 to 64 year old citizens of Shahroud city. Samples were selected through a multistage approach in 300 clusters of 20 people each. The number of clusters was determined by considering the each of the 9 primary health care centers in Shahroud one strata, and the population covered by each of these centers. The head cluster of each health care center was determined systematically from the numbers of the available household records. After identifying the head cluster, the adjacent household on the right was approached. This was repeated until all 20 people were approached by skilled interviewers who informed eligible members about the study, and eye examinations, and handed them invitation cards and the preliminary form. The interviewers were volunteers who work with the Iranian health system and serve as health mediators. The study was thoroughly explained to all participants and they signed informed consent forms before being interviewed and examined. The interview was designed to collect data on participants' demographics, occupation, socio-economic status, history of smoking, and medical and ophthalmic history.

Visual acuity tests were done to determine the uncorrected, best corrected, and the presenting or habitual vision, using a LogMAR chart at 4 meters. Tests for refraction were first done using the Topcon AR 8800 autorefractometer (Topcon Corporation, Tokyo, Japan). Then an optometrist determined the objective and subjective refraction of the participants.

Participants had eye examinations by two ophthalmologists in two stages; before and after pupil dilation. Slit lamp biomicroscopy and measurement of intraocular pressure was done before dilation. Once dilation was achieved, clinical lens opacity grading, vitreous opacity assessment with the slit lamp, and direct and indirect retinoscopy were done. Finally, the ophthalmologist recorded the presence of any visual impairment and its cause as the diagnosis. The diagnosis of pterygium and pinguecula was also made by the ophthalmologists who also graded pterygium based on the clinical appearance of the fibrovascular tissue as follows: Grade 1. Episcleral vessels still visible under pterygium; Grade 2. Episcleral vessels relatively visible under pterygium; Grade 3. Episcleral vessels totally concealed by pterygium (38).

Here we describe the prevalence of pterygium and pinguecula. For calculating the 95% confidence intervals (CI), the cluster sampling design effect was considered. We used the multiple logistic regression test to examine the association of pterygium and pinguecula with age, gender and smoking. The Chi-square test was used to study the association between pterygium and work place (indoor vs. outdoor) and education level. We used the t-test to compare people with and without pterygium in terms of visual acuity and corneal astigmatism, as well as people with and without pinguecula in terms of visual acuity. The association between the severity of pterygium and corneal astigmatism was tested with the one-way analysis of variance. In all tests, a 95% level of significance was considered.

We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research.

Results

Of the 6311 invitees aged between 40 and 64 years, 5190 people (response rate=82.2%) participated in the study. The mean age (±standard deviation) of the participants was 50.9±6.3 years, and 2213 of them (42.6%) were men. The rate of illiteracy was 8.1%; 50.0% had attended elementary school, 9.2% and 22.1% had been to middle and high school, respectively, and the remaining 10.6% had college education.

In total, 489 participants (9.4%; 95% CI, 8.6-10.3) had pterygium in at least one eye. Bilateral pterygium was observed in 148 people (2.9%; 95%CI, 2.4-3.3). Table 1 summarizes the prevalence rates of pterygium by age and gender. The prevalence of pterygium was significantly higher in men (11.4%; 95% CI, 10.1-12.8) compared to women (8.0%; 95%CI, 7.0-9.0) (P<0.001, Logistic regression).

Table 1. Prevalence of pterygium by age and gender in percentage (95% confidence interval).

Age (Year)	n	Male	Female	Total
40-44	960	9.8 (7.0-12.7)	4.6 (3.0-6.2)	6.4 (4.9-7.8)
45-49	1390	10.4 (7.9-13.0)	7.3 (5.6-9.1)	8.6 (7.1-10.1)
50-54	1285	13.1 (10.4-15.7)	7.7 (5.7-9.6)	10.1 (8.5-11.7)
55-59	954	12.5 (9.4-15.6)	10.7 (8.0-13.3)	11.5 (9.5-13.5)
60-64	601	10.5 (6.6-14.1)	12.5 (9.3-16.6)	11.6 (9.1-14.2)
Total	5190	11.4 (10.1-12.8)	8.0 (7.0-9.9)	9.4 (8.6-10.3)

The mean age in those affected by pterygium was 52.1±6.1 years, which shows a significant difference from those without pterygium (50.8±6.3 years) (P<0.001, Independent samples t-test).

Age and gender demonstrated an interaction with pterygium; in men, the prevalence of pterygium remained relatively constant with age (P<0.001, Logistic regression), while the prevalence increased significantly with age in women (P=0.002, Logistic regression) (Figure 1).

The distribution of pterygium of grades 1, 2, and 3 in the right eye was 39.1% (95%CI: 33.7-44.3), 43.3% (95% CI: 37.9-48.8) and 17.6 % (95% CI: 13.5-21.8) and in the left eye was 36.7% (95% CI: 16.3-25.3), 42.5% (95% CI: 31.4-42.1) and 20.8% (95% CI: 37.0-48.0), respectively.

The prevalence of pterygium was not significantly different between smokers (persons who smoked at least once a week for at least 6 months at some time in their lives) and nonsmokers (8.0% vs. 9.7%, respectively) (P=0.174, Chi-square test). There was no significant association between the mean age when they started smoking and number of cigarettes per day in those with and without pterygium (P=0.413 and P=0.770, respectively, Independent samples t-test) and the grade of the pterygium (P=0.362 and P=0.409, respectively, One-way ANOVA).

A significant difference was found between the prevalence of pterygium in outdoor workers (14.7% 95%CI, 12.3-17.2) compared to those who worked indoors (8.4% 95% CI, 7.5-9.3). Also, those who worked half indoors and half the time outdoors showed a significantly lesser prevalence of pterygium (9.3% 95% CI, 6.3-12.4) compared to outdoor workers (P<0.001, Chi-square test).

Figure 2 shows the association between pterygium and education. The prevalence of pterygium significantly decreased with education (P<0.001, Chi-square test); 16.5% (95% CI, 12.6-20.3) among illiterates, and 5.4% (95% CI, 3.4-7.3) among those with college education. The prevalence of pterygium significantly correlated with education in the presence of age in the multiple logistic regression model (P<0.001). Assessment of the correlation between pterygium and education (P<0.001) and outdoor work (P=0.015) in a multiple logistic regression model indicated significant correlations for all these variables with pterygium.

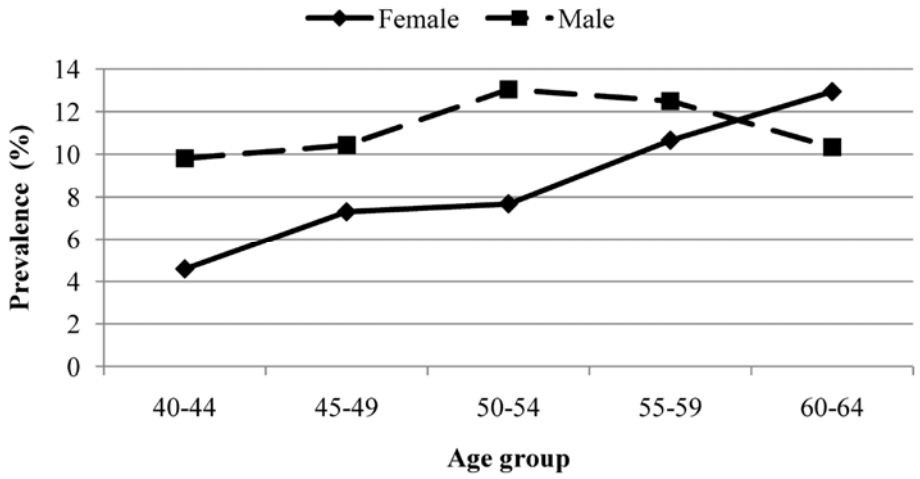

Figure 1. Prevalence of pterygium in men and women by age.

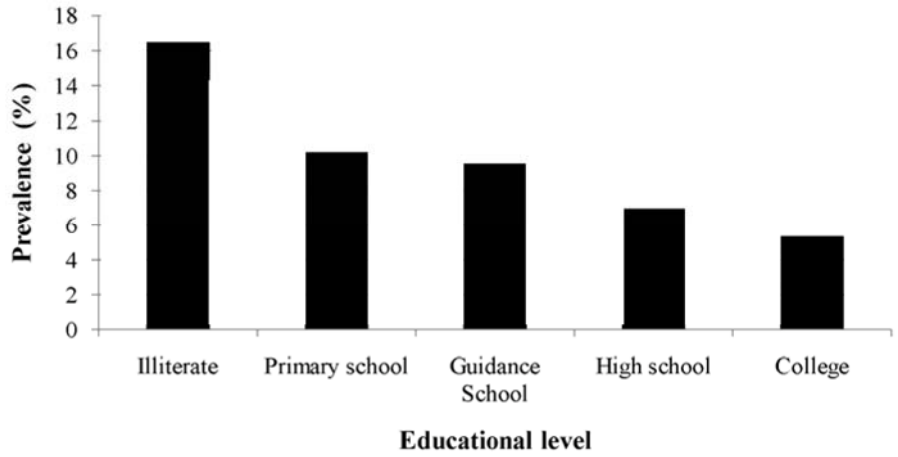

Figure 2. Association between pterygium and education.

Mean uncorrected visual acuity (UCVA) in those with and without pterygium was 0.24±0.48 and 0.23±0.44 LogMAR, respectively, and the t-test showed no significant difference between these two groups (*P*=0.796, Independent samples t-test). Mean best corrected visual acuity (BCVA) was 0.08±0.44 and 0.05±0.29 LogMAR in those with and without pterygium, respectively, and the inter-group difference was not statistically significant (*P*=0.153, Independent samples t-test). Mean BCVA in those with pterygium grades 1, 2, and 3 was 0.02, 0.11, and 0.12 LogMAR, respectively.

BCVA was significantly worse in those with grade 2 and 3 of pterygium compared to those with grade 1 (*P*=0.033, One-way ANOVA), but UCVA showed no significant difference between these three groups (*P*=0.404, One-way ANOVA).

Mean corneal astigmatism (± standard deviation) in those with and without pterygium was 1.22 ± 1.33 diopter (D) and 0.80 ± 0.73 D, respectively, and the inter-group difference was statistically significant (*P*<0.001, Independent samples t-test). Based on pterygium severity, mean corneal astigmatism was 0.92 D, 1.29 D, and 1.74 D in those with pterygium grade 1, 2, and 3, respectively (*P*<0.001, One-way ANOVA).

Among cases of pterygium, 97.8% were primary and 2.2% had recurrent pterygium. The inter-gender difference in terms of pterygium grade of severity was not statistically significant (*P*=0.300, One-way ANOVA), nor was the difference among age groups (*P*=0.248, One-way ANOVA).

Pinguecula in at least one eye was seen in 3159 people (61.0%; 95%CI, 59.1-62.9), and bilateral pinguecula was recorded for 2539 participants (49.0%; 95% CI, 47.1-50.9). Table 2 presents the prevalence of pinguecula by age and gender.

The prevalence of pinguecula was significantly higher in men (70.6%; 95% CI, 68.5-72.6) compared to women (53.8%; 95%CI, 51.4-56.3). Age and gender were significantly correlated with pinguecula (*P*=0.027, Independent samples t-test and *P*<0.001, logistic regression respectively) and there was a significant interaction (*P*<0.001, logistic regression) between age and gender with the prevalence of pinguecula.

Smokers were significantly more affected by pinguecula. The prevalence of pinguecula in smokers and nonsmokers was 71.2% and 59.4%, respectively (*P*<0.001, Chi-square test). The mean starting age of smoking and the number of cigarettes per day was not significantly different in those with and without pterygium (*P*=0.567 and *P*=0.415, respectively, Independent samples t-test).

Table 2. Prevalence of pinguecula by age and gender in percentage (95% confidence interval).

Age (Year)	n	Male	Female	Total
40-44	960	67.5 (62.1-72.9)	48.9 (44.9-52.9)	55.2 (51.8-58.6)
45-49	1390	69.3 (64.9-73.8)	54.9 (51.2-58.7)	60.8 (57.8-63.8)
50-54	1285	72.3 (68.6-76.0)	56.8 (52.8-60.9)	63.7 (60.6-66.7)
55-59	954	70.4 (66.0-74.8)	53.7 (48.9-58.6)	61.7 (58.4-65.0)
60-64	601	73.0 (68.4-78.5)	55.1 (48.1-60.6)	63.8 (59.3-67.9)
Total	5190	70.6 (68.5-72.6)	53.8 (51.4-56.3)	61.0 (59.1-62.9)

Table 3. Prevalence of pterygium reported from different parts of the world.

	Population	Age	Sample size	Prevalence (%)
1	Brazil / Amazon Rain Forest (Tukano) (23)	Adult	105	37.1
2	Brazil / Amazon Rain Forest (Arawak) (23)	Adult	160	36.6
3	China / Doumen county (26)	50≤	4214	33.01
4	Peru / Lima (20)	Adult	367	31.06
5	Japan / Kumejima (6)	40≤	3762	30.8
6	Barbados / (Black Skin) (27)	40 – 84	2617	23.4
7	USA / Farm workers of Latin American origin (25)	18≤	304	23.3
8	Croatia / Rob (18)	65 – 80	480	23.0
9	Myanmar (13)	40≤	2076	19.6
10	Africa / Central Sahara (30)	All ages	1322	18.0
11	China / Mongolian (14)	40≤	2112	17.9
12	Indonesia / Riau Archipelago (15)	All ages	477	17.0
13	Indonesia (19)	40≤	403	16.8
14	USA / American of Latin American or Spanish origin 10	40≤	4774	16.0
15	China / Tibetans (11)	40≤	2229	14.49
16	Singapore / Urban Malay (9)	40 - 79	3280	12.3
17	Jordan / Red Sea territory (24)	10≤	127	12.0
18	Iran / Shahroud (Present Study)	40 - 64	5190	9.4
19	Greenland (17)	All ages	659	8.6
20	Nigeria / Rural area (31)	18 - 49	510	8.2
21	Australia / Blue Mountain (16)	49≤	3564	7.3
22	Singapore / Chinese population (7)	40≤	1232	6.9
23	Brazil / Amazon Rain Forest (Yanomamni) (23)	Adult	316	5.4
24	Australia / Aboriginal (29)	All ages	64314	3.4
25	China / Beijing (12)	40≤	4439	2.9
26	Australia/ Victoria (22)	40≤	5147	2.83
27	Brazil / Amazon Rain Forest (Maku) (23)	Adult	43	2.3
28	Iran / Tehran (8)	All ages	4564	1.3
29	Australia / Non-aboriginal (29)	All ages	40799	1.1
30	Denmark / Copenhagen (17)	All ages	810	0.7
31	Solomon Islands (28)	All ages	512	0.3

In terms of occupation, those who had indoor jobs demonstrated a prevalence of 56.7% for pinguecula, those who worked half indoors and half outdoors had a rate of 69.3%, and the prevalence of pinguecula in outdoor workers was 76.9%; the difference between indoor and outdoor workers was statistically significant (P<0.001, Chi-square test).

The prevalence of pinguecula significantly decreased with education (P<0.001, Chi-square test); 64.1% (95% CI, 59.0-69.2) among illiterates and 54.7% (95% CI, 50.6-58.8%) in those with college education. The prevalence of pinguecula was significantly correlated with education in the presence of age in the multivariate logistic model (P<0.001).

Discussion

Many studies have described the prevalence of pterygium and pinguecula and discussed its determinants (6-20,22-31). Nonetheless, such reports from Iran are limited to the study conducted in Tehran, as the Tehran eye Study.

The prevalence of pterygium in the present study was 9.4%. Prevalence rates reported in the literature vary greatly, however in most cases they do not provide the grounds for a valid comparison because of differences in sample population size and age range. Also, in some studies, the sample may not represent the general population of the nation or region. A summary of different studies is listed in Table 3, according to

which the prevalence rates in adults range between a high 37.1% in Tukamo, Brazil (23), and a low rate of 2.8% in Melbourne, Australia (22). As for bilateral pterygium, the rate in Shahroud was 2.9%, which is lowest compared to rates reported by other studies and range between 4.1% (19) and 13.1%.6

The prevalence of pterygium in Shahroud was higher than that found in the Tehran Eye Study (8) (2.6% in the 40-59 year age group, and 7.8% in over 60 year olds). This can be attributed to different causes. One commonly suggested risk factor is working outdoors and exposure to UV light (4,6,7,9,13,20,24,27,35,39-42). According to our results, 16% of the studied population worked outdoors, and although we have no access to TES occupation data, it would be logical to assume that farming and other outdoor occupations are less common in Tehran. Even people who worked half of the time indoors and half outdoors were significantly less affected by pterygium in comparison to outdoor workers. In 2004, the number of sunny hours was 2929.8 in Shahroud and 2994.4 in Tehran but the UV index in Shahroud is at least one unit higher than that in Tehran. UV exposure, as a risk factor for pterygium (21,24,39), can partly explain the higher prevalence rate of pterygium in Shahroud compared to Tehran. Another explanation is differences in the level of education. The percentage of people with high school education and higher was smaller for Shahroud compared to Tehran (32.6% vs. 49%) (43). The residents of Shahroud are of Fars origin like the majority of Iranians. However, the effect of factors such as ethnicity and genetics should not be overlooked when Iran in compared to other countries (6,40).

In our study, the prevalence of pterygium increased with age. This finding is in agreement with other reports (6,8,9,11,12,14-17,19-23,25,27,44), but results on the role of gender in the prevalence of pterygium are inconsistent. Some, in agreement with our results, found significantly higher rates among men (6,7,12,16,22), some observed the opposite (11,44), and some studies found no significant association for gender (8,13,19,27). The increasing prevalence of pterygium with age in woman could be explained by the age cohort effect; *i.e.* elder ladies who have pterygium today, were probably more exposed to risk factors when they were young, compared to younger women today. We found no significant association between pterygium grade of severity and age or gender.

We found no significant correlation between the pterygium and smoking, and a similar observation has been reported by some other researchers (8,19), while some reports state that the prevalence of pterygium is lower among smokers (10,22,27).

Similar to other reports, the prevalence of pterygium and the level of education were significantly correlated (7,10-12,14,27) even when age was included in the model. This can be a matter of work place and exposure to UV, because those with higher education usually tend to have clerical and indoor jobs. We observed the same correlation after including work place in the model. The reason for this observation can be explored in the use of appropriate sunglasses by people with more education as the protective effect of sunglasses against pterygium has been suggested (11).

There was no significant correlation between pterygium and UCVA or BCVA in our study, while some researchers state that visual acuity is decreased in people with pterygium (12,14,19,27). This difference could be because the visual axis in our patients was less involved with pterygium than that seen in other studies. The significant BCVA difference between those with pterygium grade 1 as one group and grades 2 and 3 as the other group suggests a more extensive spread over the cornea which affects the visual axis.

The correlation between pterygium and corneal astigmatism was significant; this has been demonstrated in other studies as well (6,13-15,19,26,45,46). This can be due to 2 reasons; one is the mechanical pull of pterygium on the surface of the cornea, which distorts the corneal shape, and the other is localized tear pooling (46-48). As suggested before (13), higher grades of pterygium were significantly associated with greater amounts of corneal astigmatism. However, it must be noted that most studies have assessed the correlation between the extent of pterygium with astigmatism rather than the grading used in the present study (26,46,49-51).

The prevalence of unilateral and bilateral pinguecula in this study was 61.0% and 49.0%, respectively; the range reported previously varied from 41.0% (17) to 90.0% (24). In the Tehran Eye Study, the prevalence rate in the 40-59 year age group was 66.0%, while the prevalence in over 60 year olds was 76.8% (8). Compared to studies conducted around the world, our prevalence rate falls in the mid range, while the prevalence in Tehran was higher. Since pinguecula has quite the same risk factors as pterygium, (51) the higher prevalence rate of pterygium in Tehran compared to Shahroud is probably because people in Tehran seek surgical removal for pterygium, but such need is not felt for pinguecula.

Similar to other studies, we found that pinguecula significantly correlated with age and male gender (8,16)

and a significant correlation existed with smoking, like in Tehran (8). The significant association between the prevalence of pinguecula and outdoor working is again due to the effect of UV exposure which was discussed in case of pterygium (53). The prevalence of pinguecula significantly correlated with the level of education, probably because people with higher education tend to work indoors and are less exposed to UV light, thus less affected by pinguecula.

One of the limitations of our study is including the urban population only, and thus, results cannot help us make any judgment about the rural population. Geographically, they all live in the same area, and results do not add to our information about mountainous or coastal areas, etc. Another point is that information regarding working indoors or outdoors was collected during the interview, as claimed by the interviewee, and may not be very accurate.

In this study we found that the prevalence rates of pterygium and pinguecula in urban areas in Iran fall in the mid range and working outdoors is an important risk factor. Although UCVA and BCVA was not significantly different in those with and without pterygium, since BCVA was worse in those with grade 2 and 3, compared to those with grade 1, and corneal astigmatism is higher than in the unaffected population, surgical removal of pterygium may be necessary for them.

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