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Original research

# The prevalence of ptosis and nystagmus in rural population

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## Abstract

***Purpose***: To determine the prevalence of ptosis and nystagmus in the general rural population in Iran.

***Methods***: Two villages were selected from the north and southwest of Iran using a multi-stage cluster sampling approach. After selection of the participants and inviting them to a complete eye exam, they all had vision tests and an ophthalmic examination. Vision tests included measurement of visual acuity, refraction, and the cover test. Then the slit-lamp exam was performed, and the diagnosis of ptosis and nystagmus was determined by an ophthalmologist.

***Results***: Of the 3851 invitees, 3314 people participated in the study. The prevalence of ptosis in this study was 2.23% [95% confidence interval (CI): 1.73−2.74], and 45.3% of the cases were bilateral ptosis. The prevalence of ptosis was lowest in the 21−30 year (0.2%) and the under 5 year (0.8%) age groups, and the highest prevalence was observed in people over 70 years of age (6.7%) ($P < 0.001$). The prevalence of ptosis was higher in illiterate people than those with an academic education level ($P = 0.012$). The prevalence of astigmatism was 62.8% in those with ptosis and 34.2% in those without ptosis ($P < 0.001$). The prevalence of nystagmus was 0.39% (13 cases).

***Conclusions***: This study found that the prevalence of ptosis is relatively high in the general rural population in Iran, and the prevalence increases with age. Astigmatism is significantly high among cases with ptosis, and its prevalence has an inverse relation with the level of education. Nystagmus also had a high prevalence in this population.



*Keywords:* Ptosis; Nystagmus; Cross-sectional study; Prevalence

## Introduction

Ptosis and nystagmus are eye problems whose roles in causing visual impairment such as reduced visual acuity, strabismus, and amblyopia have been proven in various studies.[1−3] Ptosis and nystagmus affect different aspects of the patients' life by interfering with daily activities, limiting job opportunities, restricting mobility, impairing academic performance, and causing stress and psychological problems.[4,5] In addition to affecting visual function, these conditions

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contribute to major head and neck malformations on account of prolonged malposition of the head.[6]

Ptosis has a very important role in the development and progression of eye disorders. Visual deprivation due to obstruction of the visual axis, high prevalence of refractive errors, strabismus, and anisometropia leads to an increased risk of developing amblyopia in these patients.[7] The prevalence of amblyopia is 15%−48% higher in these patients.[5,8,9] On the other hand, recent studies have shown that the risk of ptosis is significantly increased in acquired conditions such as neurologic diabetes, hypertension, and other systemic diseases.[10] There are few population-based studies reporting on ptosis, and reported prevalence rates in existing studies on the general population are very diverse, ranging from about one percent in children to over 10% in adults.[11,12] The majority of the studies on this subject are clinical non-population-based studies.

Nystagmus is a pathological disorder of eye movements, and its significant prevalence is reported in the Asian race.[13] Studies on the prevalence of nystagmus are also rare and often limited to children, have small sample sizes, and are not population-based. A review of these studies showed that the prevalence of nystagmus in children is relatively high at about 1 in 1500 to 1 in 1000.[14,15] The only population-based study conducted in Europe estimated an overall prevalence of 24 in 10,000 for nystagmus.[13]

Despite the importance of ptosis and nystagmus in the development of visual impairment, the prevalence of these conditions in the general population is unknown, and estimates are limited to a few studies in certain age groups and with very small sample sizes. Since knowledge of their prevalence in the general population is required for planning and applying preventive interventions and expanding the appropriate therapeutic methods, the aim of this study was to determine the prevalence of ptosis and nystagmus in an Iranian rural population.

## Methods

The present cross-sectional study was conducted in Iran in 2015. The target population in the present study was the underserved Iranian rural population. The Ethics Committee of Shahid Beheshti University of Medical Sciences approved the study protocol, and the study was conducted in accord with the tenets of the Declaration of Helsinki. All participants signed a written informed consent. For persons under 18 years, the head of the household signed the consent form. The sampling and methodology of the study has been reported elsewhere previously.[16−19] A brief description of the methodology is presented here.

The participants of this study were selected through a multistage cluster sampling approach. First, we used national data to randomly choose two districts from the north and southwest of the country. Selected districts were Shahyoun in the southwest (a district of Dezful County, Khuzestan Province) and Kajour in the north (a district of Noshahr County, Mazandaran Province). In the next stage, rosters of all villages in these districts were prepared, and a number of villages were then randomly selected.

Sampling from each district was proportional to their total population and with respect to the sample size calculated for the study. Therefore, to maintain the right balance, the number of sampled villages in Shahyoun and Kajour was 15 and 5, respectively, because the former district has smaller and less populated villages. In each selected village, all over-one-year old residents in selected households were considered for inclusion and invited to participate in the study.

On the day of the appointment, after obtaining informed consents, an interview was conducted to collect demographic data. Then vision tests were performed by two optometrists. For each participant, first the uncorrected visual acuity (UCVA) was determined with the Snellen E chart at 6 m. For children 5 years of age and under, the Lea Symbols acuity chart was used. To test objective refraction, first autorefraction was done with the Nidek Ref/Keratometer ARK-510A, and results were refined through retinoscopy (Heine Beta 200 Retinoscope, HEINE Optotechnik, Germany). Cases with UCVA worse than 20/20 also underwent subjective refraction to determine their best corrected distance visual acuity. Preliminary examinations were done by a trained optometrist and abnormal or suspicious cases were subjected to more detailed examinations by an ophthalmologist. The slit-lamp examinations, nystagmus, and ptosis diagnosis were performed by an ophthalmologist for each participant.

The diagnosis of ptosis was based on the margin reflex distance (MRD1) which is the distance from the upper eyelid margin to the corneal light reflex. An MRD1< 4 mm was considered ptosis. Since there was no information regarding their history of ptosis (congenital or acquired), only the presence or absence of ptosis was recorded for each case, and the type was not specified. Nystagmus is an abnormal repetitive, rhythmic, oscillation of one or both eyes that is caused by a slow deviation of fixation which is followed by a slow movement back to fixation point (pendular nystagmus) or a fast refixation saccade (jerk nystagmus) whose direction, amplitude, and frequency is variable. Astigmatism was recorded as a negative cylinder power and determined based on cut points more than 0.5 diopter.

The prevalence of ptosis and nystagmus are summarized as percentages. The effect of cluster sampling was taken into account in calculating the standard error.

## Results

Of the 3851 persons invited from 17 underprivileged villages in northern and southwestern regions of Iran, 84.5% (n = 3314) participated in the study. The mean age of the participants was 37.4 ± 21.4 years old (range, 2−93 years); 56.3% (n = 1867) were female, and 56.4% (n = 1869) were residents of southwestern villages in Iran.

In this study, 74 cases of ptosis were identified. Therefore, the prevalence of ptosis was 2.23% [95% confidence interval (CI): 1.73−2.74]; the prevalence of unilateral and bilateral ptosis was 1.20% and 1.03%, respectively. Of the 74 cases of ptosis, 45.3% (n = 34) had bilateral ptosis. Table 1 shows the prevalence of ptosis by age, gender, region, and educational

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Table 1
The prevalence of ptosis in the rural population according to gender, age, region, and education.

| | | n | % (95%CI) |
|---|---|---|---|
| | Total | 3314 | 2.23 (1.73−2.74) |
| Gender | Female | 1834 | 2.50 (1.79−3.21) |
| | Male | 1421 | 2.00 (1.27−2.73) |
| Age | =<5 | 129 | 0.80 (0.02−4.30)[a] |
| | 6−20 | 757 | 1.10 (0.36−1.84) |
| | 21−30 | 439 | 0.20 (0.006−1.27)[a] |
| | 31−40 | 486 | 1.60 (0.48−2.72) |
| | 41−50 | 513 | 2.70 (1.30−4.10) |
| | 51−60 | 450 | 2.90 (1.35−4.45) |
| | 61−70 | 226 | 4.90 (2.09−7.71) |
| | >70 | 255 | 6.70 (3.63−9.77) |
| Educational level | Illiterate | 1086 | 3.30 (2.24−4.36) |
| | Primary school | 964 | 2.30 (1.35−3.25) |
| | Guidance school | 347 | 2.00 (0.53−3.47) |
| | High school | 614 | 1.10 (0.27−1.93) |
| | College | 244 | 0.40 (0.09−2.28)[a] |
| Region | Southwest | 1835 | 2.70 (1.96−3.44) |
| | North | 1419 | 1.70 (1.03−2.37) |

CI: Confidence interval.
[a] The 95%CI was calculated by binomial distribution.

level. The results of the Chi-square test showed that the prevalence of ptosis was significantly different among age subgroups ($P < 0.001$). The prevalence of ptosis was lowest in the 21−30 year age group (0.2%) and the under five year age group (0.80%), and the highest prevalence was observed in people over 70 years of age (6.7%).

Ptosis prevalence had an inverse relation with the level of education, such that its prevalence in illiterate people was more than 8-fold higher than those with academic education (3.30% vs. 0.40%) ($P = 0.012$).

Comparisons by gender and residence region showed no significant difference in the prevalence of ptosis.

The prevalence of astigmatism (cylinder power >0.5 diopter) was significantly higher in cases with ptosis ($P < 0.001$); the prevalence was 62.8% in those with ptosis and 34.2% in those without ptosis. The findings of this study showed that the mean astigmatic refraction, according to the right eye results, was 1.04 ± 0.88 D in ptotic and 0.68 ± 0.81 D in non-ptotic subjects ($P = 0.011$).

The prevalence of with-the-rule (WTR), against-the-rule (ATR), and oblique astigmatism was 37.1%, 17.1%, and 7.6% in ptotic and 17.3%, 13.4%, and 3.6% in non-ptotic participants, respectively ($P < 0.001$).

According to the results, 19 out of 74 ptotic cases were amblyopic. The prevalence of amblyopia was 25.7% (15.5−40.1%) in ptotic and 1.2% (0.8−1.6%) in non-ptotic individuals. Logistic regression analysis showed a significant association between ptosis and amblyopia ($P < 0.001$).

The prevalence of nystagmus in this study was 0.39% (95% CI: 0.21−0.66) (n = 13). Six patients had vertical and 4 patients had horizontal nystagmus. The nystagmus type was not specified in 3 cases. Eight patients were girls, and 5 were boys. The ptosis and nystagmus were not associated with other ocular or facial and cerebral abnormalities. No patient with nystagmus had ptosis.

## Discussion

The present study is one of the few population-based studies on the prevalence of ptosis and nystagmus in different age groups with a large sample size. The results of this study showed that the overall prevalence of ptosis and nystagmus in the general rural population in Iran is 2.2% and 0.4%, respectively.

As mentioned, the overall prevalence of ptosis in this study was estimated at 2.2% which is relatively high compared with results of the only population-based study by Hashemi et al. who reported an estimate of 0.9% in the urban population of Tehran.[8] In contrast, it is relatively low compared with a study by Sridharan et al. who estimated the overall ptosis prevalence to be 11.5% in their sample of 400 residents of Manchester over 50 years of age.[11] In the Shahroud Eye Cohort Study in northern Iran, the prevalence of ptosis in the 65−69 year age group was 5.8%.[10] We also estimated ptosis prevalence in the 6−20 year age group to be 1.1%. This is relatively high compared with estimates in children in Egypt, Dezful in Iran, and China which were 0.79%, 0.80%, and 0.19%, respectively.[12,20,21]

Studies investigating the prevalence of ptosis in the general population are very few (Table 2), hence, there is limited possibility to compare the results; however, the differences in

Table 2
Summary of previous studies available on the prevalence of ptosis and nystagmus around the world.

| Diseases | Place, Years | Sample size | Age | Prevalence |
|---|---|---|---|---|
| Nystagmus | Denmark, 1964[2] | a cohort | 15−18 yr | 1 in 500,000 |
| | Sweden, 1971[14] | 61,680 | 7 yr | 1 in 1500 |
| | China, 1987[20] | 272,931 | Children | 1 in 4014 |
| | United Kingdom, 1988[15] | 15,000 | 10 yr | 1 in 1000 |
| | Bradford, England, 2002[22] | 72 | 5−16 yr | 26.4 in 100 |
| | Leicestershire and Rutland in the United Kingdom, 2009[13] | 845 | All age group | 24 in 10,000 |
| | China, Shanghai, 2014[18] | 9512 | 7−12 yr | 2 in 10,000 |
| Ptosis | England, Manchester, 1995[11] | 400 | >50 yr | % 11.5 |
| | Iran, Tehran, 2010[8] | 4565 | All age group | % 0.90 |
| | Iran, 2015[9] | 4106 | 7 yr | % 1.41 |
| | Egypt, South Sinai, 2015[12] | 2070 | 5.5−17 yr | % 0.79 |
| | Iran, Shahroud, 2016[10] | 4737 | 40−64 yr | % 4.7 |
| | Iran, Dezful, 2016[21] | 1375 | 7−18 yr | % 0.8 |
| | China, 1987[20] | 247,389 | Children | 0.18 (1 in 552) |

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the results of this study compared with other studies may be due to the larger sample size, wider age range, and consequently, the inclusion of more cases of acquired ptosis in this study.

On the other hand, this study was done in a rural population, and previous studies have shown the results of this study showed that about 45% of ptosis cases identified in this study were bilateral ptosis, and this ratio was not very different from that reported in previous studies. In the population-based study in Tehran, 44% of cases had bilateral ptosis,[8] and overall, most studies have reported that 30−40% of their cases were bilateral.[11,23]

The results of this study showed that the prevalence of ptosis significantly differed among age subgroups, and except for the 21−30 year age group which had the lowest prevalence, other age groups followed an ascending trend. The trend was faster after the age of 60 years; it reached 4.9% in the 61−70 year age group and 6.7% in those over 70 years. Based on these results, older age is an important factor in the development of ptosis, a point which was also observed by Hashemi et al. and Sridharan et al.[10,11] Ptosis develops following the relaxation of the levator palpebrae muscle and damage to its innervation, and the natural process of aging plays an important role in this process. Also, the higher prevalence of eye diseases such as cataract and glaucoma in older ages, and consequently a higher rate of surgery, as well as the higher prevalence of metabolic disorders such as diabetes and hypertension may all contribute to the higher prevalence of ptosis in adults.[10,24,25]

According to the results of the present study, ptosis was significantly more common among illiterate people compared to those with academic education (3.3 versus 0.4). However, the relationship between ptosis and education level was not examined in previous studies, and it is not possible to compare results with other studies. It seems that education is a confounding factor. In fact, people with lower education levels are often involved with high-risk jobs.[26] Exposure to unsafe job conditions increases the risk of head injuries and trauma, which can explain the higher prevalence of ptosis in these individuals.

The results of this study showed that the prevalence of astigmatism was significantly higher in cases of ptosis. Astigmatism is a common finding in patients with ptosis, especially in congenital ptosis. In a survey among 55 patients with congenital ptosis, Reddy and Kamala showed that the prevalence of refractive errors in patients with ptosis was about 36%, and 82% of these refractive errors were corneal astigmatism.[27] The pressure exerted on the cornea by the eyelid and the consequent change in corneal curvature are the main reasons for the development of astigmatism in these cases. In line with the results of this study, the population-based study of 4734 residents of Shahroud in the north of Iran by Hashemi et al. showed that the prevalence of astigmatism more than 1 diopter was 32.6% in patients with ptosis and 28.5% in cases without ptosis.[10]

This study showed that the prevalence of nystagmus in the general rural population in Iran is relatively high at about 4 in 1000. Previous studies have not examined the prevalence of nystagmus exclusively, and it has only been studied as part of epidemiological studies on cases with refractive errors or only in children (Table 2). Therefore, the possibility to compare the results of this study is very limited. The prevalence of nystagmus reported in children ranges from of 1 in 500,000 people in Denmark to 26.4 in 100 people in the UK.[2,22] In the only population-based study which was conducted by Sarvananthan et al., the prevalence of nystagmus was estimated to be 24 in 10,000, which is very low compared to the present study.[13] The mentioned study included different races and concluded that the prevalence of nystagmus was relatively high in the Asian race which comprised about 20−30% of the cases.

In this study, the type or degree of ptosis was not investigated, nor was the type of nystagmus or its etiology (congenital and acquired). Despite these limitations, this study is one of the few studies reporting the prevalence of ptosis and nystagmus in a large sample size and wide age range in the general rural population in Iran.

In conclusion, this study showed that ptosis is relatively common in the general rural population in Iran, and its prevalence increases with age. The prevalence of astigmatism is significantly high in patients with ptosis, and the prevalence of ptosis is inversely related with the level of education. Nystagmus was also highly prevalent in this population.

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