Review

The prevalence of amblyopia in Iran: A systematic review

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Abstract

Purpose: The aim of this study was to determine the prevalence of amblyopia in the population of Iran.

Methods: This article is a systematic review. A comprehensive search was conducted in PubMed, Scopus, Science Direct, Ovid, Web of Science, SID, Magiran, with appropriate terms. Information related to the sample size and the prevalence of amblyopia was extracted and summarized in tables. Analysis was performed using STATA software.

Results: From 551 articles that were originally extracted from the databases, 31 articles met the criteria for entering the review. These studies were conducted in different regions of Iran. The prevalence of amblyopia in different regions varied between 0.19 and 3.69%. Study results were heterogeneous ($I^2 = 99.7\%$), and therefore, a meta-analysis was not done.

Conclusions: The prevalence of amblyopia in Iran is very different. In addition to conducting national screenings, it is necessary to report the incidence of amblyopia and its related factors in different parts of the country.

Keywords: Amblyopia; Systematic review; Iran; Prevalence

Introduction

Amblyopia, or Lazy Eye, is a kind of visual impairment with no physical defect in the eyes or in the optic nerve. While this type of disorder can cause visual impairment or blindness in the absence of timely diagnosis and treatment, with early diagnosis, many of its possible complications are reduced.

When one eye develops naturally and the other eye does not, the lagged eye becomes visually impaired, or in other words, lazy. Although in most cases the defect happens in one eye, bilateral amblyopia is also possible.

Several factors can lead to this defect, including congenital abnormalities in the eye structure such as cataracts, ptosis, strabismus, and refractive problems such as myopia, and astigmatism. Some studies have referred to strabismus as the most common cause of amblyopia.

Amblyopia can cause consequences such as learning impairment and failure in education and communication. There is also evidence that, in addition to imposing an economic burden on the society, this disease causes unusual psychological disorders, social anxiety, and inability to perform in group activities.
A wide range has been reported for the prevalence of this disorder worldwide, which has been from 0.2 to 6.2.\textsuperscript{12–17} Several studies in different regions of Iran have also reported the prevalence of amblyopia.\textsuperscript{18–27} Awareness of the prevalence of this type of visual impairment provides the required information for policy makers to plan for timely prevention, diagnosis, and treatment. In this article, we systematically review studies about the prevalence of amblyopia in Iran.

Methods

Search strategy and inclusion criteria

The inclusion criteria were studies which reported the prevalence of amblyopia among an Iranian-based population and diagnosed amblyopia with any screening tool.

Studies were not excluded based on publication status, language, type of screening tool, or etc. In this paper, both English and Persian keywords were used to search for articles. The search was restricted to studies done in Iran.

Studies were identified by searching PubMed, Embase, Web of Science, Scopus, Ovid, SID, Civilica and Magiran. Conference proceedings were searched in Scopus and Civilica, and dissertations were searched in the Irandoc website. The search was done up to 22 October 2017. It took about one week to do the full search.

The search terms used were Amblyopias; Lazy Eye; Eye, Lazy; Eyes, Lazy; Lazy Eyes; Anisometropic Amblyopia; Amblyopia, Anisometropic; Amblyopias, Anisometropic; Anisometric Amblyopias; Amblyopia, Developmental; Amblyopias, Developmental; Developmental Amblyopia; Developmental Amblyopias; Amblyopia, Suppression; Amblyopias, Suppression; Suppression Amblyopia; Suppression Amblyopias; Stimulus Deprivation-Induced Amblyopia; Stimulus Deprivation-Induced Amblyopia; Amblyopia, Stimulus Deprivation-Induced; Amblyopia, Stimulus Deprivation Induced; Amblyopias, Stimulus Deprivation-Induced; Deprivation-Induced Amblyopia, Stimulus; Deprivation-Induced Amblyopias; Stimulus; Stimulus Deprivation-Induced Amblyopias; Prevalence; Incidence; Frequency; Occurrence; Iran. Details about the search strategy and the results can be found in the article Appendix.

All retrieved articles were sent to Endnote, and after that, duplicates were removed. Then based on the title and abstract of the articles, unrelated articles were excluded. Subsequently,

![Fig. 1. Flowchart of study selection.](image-url)
the full text of the remaining articles was downloaded and inspected and irrelevant articles were excluded again.

Screening tools

Clinically, unilateral amblyopia is defined as a 2-line difference in visual acuity (VA) between two eyes, where the eye with the poor eyesight has a rating of \(\leq 20/32\), and bilateral amblyopia is a bilateral reduction in VA presentation due to history of either obstruction in the bilateral vision axis or significant bilateral ametropia. The devices used for screening amblyopia include plus-optix photo-screeners (SO4, SO8, SO9) and Esnelen charts (E-chart). 38

Data extraction and quality assessment

Extracted data included the first author's name, year of publication, location of studies, sample size, and the prevalence of amblyopia. Quality assessment was not done as we did not find a widely accepted tool for quality assessment of surveys such as the studies used in this review. 39

Statistical analysis

Statistical heterogeneity among studies was assessed with the \(Q\) and \(I^2\) statistics. 40 We assessed the impact of some variables on study prevalence results through meta-regression. Stata (version 12.0) was used for statistical analyses.

Results

Eventually, 31 articles remained in the review. The screening steps and the number of articles excluded in each step are shown in Fig. 1. We found some dissertations that could have been related, but we did not have access to the abstract or full text and therefore could not include them.

| First author                  | Publication year | Cities                              | Sample Size | Participants | Prevalence (in 10\(^2\)) | Sampling procedure                      |
|-------------------------------|------------------|-------------------------------------|-------------|--------------|--------------------------|-----------------------------------------|
| 1 Hashemi et al. 14           | 2014             | Sari, Birjand, Ardabil, Meshhad     | 3675        | 7-year-old   | 1.88                     | Cluster sampling                        |
| 2 Hashemi et al. 18           | 2015             | Sari, Birjand, Ardabil, Meshhad     | 4106        | 7 years      | 0.89                     | Multistage randomized                   |
| 3 Mohammadzadeh et al. 19     | 2009             | Mashhad                             | 2400        | 6–7 years    | 0.19                     | Cluster sampling                        |
| 4 Faghihi et al. 20           | 2011             | Mashhad                             | 2150        | 6–21 years   | 1.9                      | Cluster sampling                        |
| 5 Ostadi Moghaddam et al. 23  | 2015             | Mashhad                             | 506         | 7–22 years   | 1.2                      | Cluster sampling                        |
| 6 Yekta et al. 22             | 2016             | Mashhad                             | 3654        | 4–6 years    | 0.41                     | Random multistage cluster sampling     |
| 7 Ojaghi et al. 23            | 2016             | Ardabil                             | 38,844      | 2–6 years    | 1.9                      | Not reported                            |
| 8 Masumi et al. 24            | 2011             | Ardabil                             | 4548        | 11–17 years  | 2.63                     | Not reported                            |
| 9 Azami et al. 25             | 2004             | Ardabil                             | 8427        | 3–6 years    | 1.42                     | Not reported                            |
| 10 Ostadi Moghadam et al. 26  | 2009             | Mashhad                             | 2150        | Schoolchildren | 1.9              | Random cluster sampling                 |
| 11 Shakeri et al. 27          | 2006             | Mashhad                             | 2130        | 7–11 years   | 0.8                      | Population proportional size            |
| 12 Merat 28                   | 2002             | Qazvin                               | 1380        | 6–9 years    | 4.3                      | Not reported                            |
| 13 Ghasemi 29                 | 2000             | Qazvin                               | 510         | 4–61 years   | 6.21                     | Not reported                            |
| 14 Yekta et al. 30            | 2010             | Shiraz                               | 2638        | 7–17 years   | 2.29                     | Random cluster sampling                 |
| 15 Yekta et al. 31            | 2010             | Shiraz                               | 2683        | 6–15 years   | 2.31                     | Random cluster sampling                 |
| 16 Fotouhi et al. 32          | 2007             | Dezful                               | 5544        | Schoolchildren | 0.91              | Random cluster sampling                 |
| 17 Yekta et al. 33            | 2016             | Dezful                               | 1375        | Schoolchildren | 2.7                       | Multistage cluster sampling            |
| 18 Hashemi et al. 34          | 2011             | Tehran                               | 3519        | 5–86 years   | 3.69                     | Multistage (clustering & stratification) |
| 19 Rajavi et al. 35           | 2015             | Tehran                               | 2160        | Schoolchildren (Primary) | 2.1                  | Random cluster sampling                 |
| 20 Rajavi et al. 36           | 2015             | Tehran                               | 2410        | 7–12 years   | 2.3                      | Random cluster sampling                 |
| 21 Faghihi et al. 37          | 2012             | Varamin                              | 1133        | 14–18 years  | 2.1                      | Random cluster sampling                 |
| 22 Jamali et al. 34           | 2009             | Shahroud                             | 815         | 6 years      | 1.7                      | Random sampling                        |
| 23 Safari Moradabadi et al. 42| 2014             | Bandar Abbas                         | 16,599      | 2–6 years    | 0.96                     | Not reported                            |
| 24 Ouji et al. 45             | 2000             | Fasa                                 | 1224        | Schoolchildren (Primary) | 2.28              | Systematic random                      |
| 25 Omidian et al. 46          | 2000             | Kermanshah                           | 4533        | Schoolchildren (Primary) | 0.33                  | Random cluster sampling                 |
| 26 Yekta et al. 47            | 2011             | Bojnourd                             | 1551        | Schoolchildren (Primary) | 2.3                       | Multistage (clustering & stratification) |
| 27 Sharifi and Heshmat 49     | 2004             | Oroumieh                             | 55,000      | 6–10 years   | 2.2                      | Not reported                            |
| 28 Salehi and Lotfizadeh 48   | 1999             | Shahrekord                           | 2000        | School children | 2.5                    | Not reported                            |
| 29 Khandekar et al. 41        | 2009             | In all provinces of Iran             | 1,433,540   | 3–6 years    | 1.25                     | Not reported                            |
| 30 Hamidi et al. 43           | 2014             | Bojnourd                             | 14,061      | 3–6 years    | 0.49                     | Not reported                            |
| 31 Rafiei et al. 48           | 2017             | In all provinces of Iran             | 24,398,458  | 3–6 years    | 0.5                      | Not reported                            |
The selected studies are summarized in Table 1. These studies were conducted in different parts of Iran, between 1999 and 2017. All of the papers used in this study were cross-sectional. Most studies were conducted in Mashhad and Ardebil. The reported prevalences were very different and varied from 0.19% to 3.69%.

The lowest prevalence of amblyopia (0.19%) was in Mashhad, and the highest prevalence (3.69%) was in Tehran. In the Mashhad study, the population under study were children screened before entering school. In the Tehran study, the population under study were people from 5 to 86 years. The age range of participants in all included studies was between 2 and 86 years.

The main target group in six articles were children up to six years old, and in 20 articles, the subjects aged from 6 to 22 years old. In two articles, the elderly age group was also included. In most cases, cluster sampling was done, and in others, random sampling had been used. However, in some articles, the method of sampling was not clearly indicated.

The details of each study, based on sample size, place of study, participants, quality, and prevalence of amblyopia is shown in Table 1.

The results of studies done in different cities of Iran and in different years have been shown on a map in Fig. 2. Each column represents a separate study in that city.

The prevalence of amblyopia was highly heterogeneous among the remaining 31 articles (I² = 99.7%, Heterogeneity Chi-square = 8136.76, d.f. = 28, P < 0.001). According to the Galbraith chart, some studies were outside the 95% confidence range. Since the studies were heterogeneous, calculating the pooled prevalence of amblyopia was not possible.

The relation between amblyopia and two continuous variables, which were the year of publication, and the sample size were investigated by meta-regression, and no significant association was found. The results of the meta-regression analysis are shown in Table 2.

The funnel plot of the included studies can be seen in Fig. 3. The funnel plot is very asymmetric. The reason is more likely the heterogeneity of studies and not selection bias.

Discussion

This study was, as far as we know, the first systematic review article about the prevalence of amblyopia in Iran. The prevalence of amblyopia in Iran was 0.19%—3.9%.

The prevalence of amblyopia in specific populations, such as those referred to medical centers and clinics, and clinical
samples, cannot accurately estimate the prevalence in the general population.51

In this systematic review, we tried to include all articles that reported the prevalence of amblyopia until October 22, 2017 in any part of Iran, in order to estimate the general prevalence of amblyopia in Iran.

As previously mentioned, amblyopia may exist in both adults and children, but the golden time for diagnosis and treatment of visual impairment is childhood. In this systematic review article, due to the difference in the age ranges of subjects studied in different articles, it was not possible to perform separate analyzes in different age groups.

There are several causes for amblyopia, including congenital abnormalities in the eye structure such as cataracts and ptosis, strabismus, and refractive problems such as myopia, and astigmatism.8 One of the most common causes is strabismus and anisometropia.52

In this systematic review article, it was not possible to report a pooled prevalence. In general, the reported prevalences in these studies can be divided into three categories. Studies from Dezful (2007),32 Tehran (2011),18 Mashhad (2009, 2006, 2016),19,22,27 Bandar Abbas, Dezful, Arak and Yazd (2014),14 and Ardabil (2004, 2016)15,25 reported the prevalence between 1 and 2%; and the third category of articles, from Varamin (2012), Tehran (2015), Shiraz and Dezful (2016, 2010), Ardabil (2011), Oroumieh (2004),49 showed a prevalence between 2% and 3%. Only Hashemi et al.’s study from Tehran (2011)34 reported an over 3% prevalence.29

Two studies, one conducted by Khandekar et al.41 and the other conducted by Rafiei et al.,38 reported results of amblyopia screening in all provinces of Iran. In Khandekar’s study conducted in 2006,41 the prevalence of amblyopia in Iran was 1.25%, and in Rafiee’s study, the average prevalence of amblyopia was estimated to be 0.5% and ranged from 0.26% (0.25%–0.27%) to 0.95% (0.93%–0.97%) during 2000–2013.38

Several studies have reported the prevalence of amblyopia in different countries of the world. In a study by Xiao et al. in 2015, the prevalence of amblyopia was reported to be 0.28% among African, 0.35% in Nepali, 0.52% in Malay, 0.62% in Indian, 0.93% in Chinese, and 1.43% in Hispanic children.53 Xiao’s study did not show a relation between amblyopia and age or gender. 51

Other studies have shown a prevalence of 0.2% in school children aged 7–19 years in Tanzania,54 1.8% in Australian

| Variable       | Coefficient | Std. Err. | t    | P>|t| | [95% Confidence interval] |
|----------------|-------------|-----------|------|------|---------------------------|
| Publication year | 0.00002     | 0.0003359 | 0.06 | 0.953 | -0.0006706 – 0.0007105    |
| Sample size    | -4.90e-10    | 3.64e-10  | -1.35 | 0.189 | -1.24e-09 – 2.57e-10      |
| Cons           | -0.0255327   | 0.6752457 | -0.03 | 0.972 | -1.411516 – 1.364451      |

Fig. 3. Funnel plot to access publication bias. Each point represents a separate study.

Table 2
Meta-regression analysis on the effect of publication year and sample size on the reported prevalence of amblyopia in Iran.
school children aged 6 years, 2.8% among adults 30–80 years in a rural Chinese population, and 3.6% in British children aged 7 years.

In a review about amblyopia published in 2005, the prevalence of amblyopia was in the range of 1.6%–3.6%, and there were no significant ethnic/racial differences in prevalence. All of these studies confirm the various prevalence of amblyopia in different regions of the world.

In this systematic review, the prevalence has been reported in different parts of Iran, but even in cases where studies had been done in a particular province, the prevalence of amblyopia was variable. Therefore, the prevalence of amblyopia does not seem to have a specific geographical distribution in Iran.

We do not know the reason for this difference in amblyopia prevalence in Iran, and we did not find anything in the literature neither.

It seems like the observed difference among the studies may be due to the populational groups under study, the situation of the research, and the skill of the staff to diagnose amblyopia.

One of the limitations of this study was the lack of information about the prevalence of amblyopia from all provinces across the country separately. The lack of sufficient information in published articles makes it difficult to estimate the overall prevalence. Also, some studies did not report sufficient information about sampling, measuring and diagnostic tools, type of amblyopia, unilateral or bilateral defects, prevalence in gender subgroups, and the probable causes of amblyopia.

Studies on amblyopia in Iran are highly heterogeneous, and according to these studies, the prevalence of amblyopia in Iran is between 0.19 and 3.69%.

Appendix.

Search strategy:

**Embase:** 7
amblyopias OR 'lazy eye' OR 'eye, lazy' OR 'eyes, lazy' OR 'lazy eyes' OR 'amblyopias, anisometropic' OR 'amblyopia, anisometropic' OR 'amblyopias, anisometropic' OR 'amblyopia, developmental' OR 'amblyopias, developmental' OR 'developmental amblyopia' OR 'developmental amblyopias' OR 'amblyopia, suppression' OR 'amblyopias, suppression' OR 'suppression amblyopia' OR 'suppression amblyopias' OR 'stimulus deprivation-induced amblyopia' OR 'stimulus deprivation induced amblyopia' OR 'amblyopia, stimulus deprivation-induced' OR 'amblyopia, stimulus deprivation induced' OR 'amblyopias, stimulus deprivation-induced' OR 'deprivation-induced amblyopia, stimulus' OR 'deprivation-induced amblyopias, stimulus' OR 'stimulus deprivation-induced amblyopia, stimulus' OR 'stimulus deprivation-induced amblyopias, stimulus' OR 'visual defects' OR 'refractive eye' AND (prevalence OR incidence OR epidemiology OR occurrence) AND iran

| Ovid: 22                                      |
|----------------------------------------------|
| 1 (amblyopias or "lazy eye" or "Eye, Lazy" or "Eyes, Lazy" or "Lazy Eyes") | 265 |
| 2 ("Amblyopia, Anisometropic Amblyopias" or "Amblyopia, Anisometropic" or "Amblyopias, Anisometropic" or "Anisometropic Amblyopias" or "Amblyopia, Developmental" or "Amblyopias, Developmental" or "Developmental Amblyopia" or "Developmental Amblyopias") | 788 |
| 3 ("Amblyopia, Suppression" or "Amblyopias, Suppression" or "Suppression Amblyopia" or "Suppression Amblyopias") | 85  |
| 4 ("visual defects" or "refractive eye") | 1653|
| 5 (occurrence or epidemiology or incidence or prevalence or frequency) | 2,249,489|
| 6 Iran.af. | 49,267|
| 7 1,2,3,4 (OR) | 2656|
| 8 7,5,6(AND) | 22 |

| PubMed: 51                                      |
|------------------------------------------------|
| (((Amblyopia OR "visual impairment" OR "visual disorders" OR "visual defects" OR "refractive eye") AND (prevalence[Text Word] OR incidence [Text Word] OR frequency[Text Word] OR epidemiology[Text Word])) AND IRAN[Text Word]) |

| Scopus: 246                                      |
|------------------------------------------------|
| 1 (ALL (amblyopias) OR ALL (lazy eye) OR ALL (eye, lazy) OR ALL (eyes, lazy) OR ALL (lazy eyes)) | 1  |
| 2 ALL ("Anisometropic Amblyopia") OR ALL ("Amblyopia, Anisometropic") OR ALL ("Amblyopias, Anisometropic") OR ALL ("Anisometropic Amblyopias") OR ALL ("Amblyopia, Developmental") OR ALL ("Amblyopias, Developmental") OR ALL ("Developmental Amblyopia") OR ALL ("Developmental Amblyopias") | 2  |
| 3 ALL (amblyopia, suppression) OR ALL (amblyopias, suppression) OR ALL (suppression amblyopia) OR ALL (suppression amblyopias) OR ALL (stimulus deprivation-induced amblyopia) OR ALL (stimulus deprivation induced amblyopia) | 4  |
| 4 ALL (amblyopia, stimulus deprivation-induced) OR ALL (amblyopia, stimulus deprivation induced) OR ALL (amblyopias, stimulus deprivation-induced) OR ALL (deprivation-induced amblyopia, stimulus) OR ALL (deprivation-induced amblyopias, stimulus) OR ALL (stimulus deprivation-induced amblyopia, stimulus) OR ALL (stimulus deprivation-induced amblyopias, stimulus) | 5  |
| 5 ALL ("refractive eye") OR ALL ("visual defects") OR ALL ("visual disorders") OR ALL ("visual impairment") | 6  |
| 6 TITLE-ABS-KEY (iran) | 7 |
| 7 (ALL (prevalence) OR ALL (incidence) OR ALL (frequency) OR ALL (epidemiology) OR ALL (occurrence)) | 22 |
Web of Science: 54

TOPIC: ((Amblyopia OR Amblyopias OR “Lazy Eye” OR “Eye, Lazy” OR “Eyes, Lazy” OR “Lazy Eyes” OR “Anisometric Amblyopia” OR “Amblyopia, Anisometric” OR “Amblyopias, Anisometric” OR “Anisometric Amblyopias” OR “Amblyopia, Developmental” OR “Developmental Amblyopia” OR “Amblyopias, Developmental” OR “Developmental Amblyopias” OR “Amblyopia, Suppression” OR “Amblyopias, Suppression” OR “Suppression Amblyopias” OR “Stimulus Deprivation-Induced Amblyopia” OR “Stimulus Deprivation Induced Amblyopia” OR “Amblyopia, Stimulus Deprivation-Induced” OR “Amblyopias, Stimulus Deprivation-Induced” OR “Deprivation-Induced Amblyopia, Stimulus” OR “Stimulus Deprivation-Induced Amblyopias” OR “refractive eye” OR “visual defects” OR “visual disorders” OR “visual impairment”)) AND TOPIC: ((incidence OR prevalence OR frequency OR OCCURRENCE)) AND TOPIC: (IRAN)

SIIH: 29

Amblyopia, Lazy Eye, Prevalence

Magiran: 141

Amblyopia

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