Original Article

The Prevalence of Accommodative Isufficiency in a Higher Education Student Population

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Abstract

Purpose: To survey the prevalence of accommodative insufficiency in a higher education student population from Iran University of Medical Sciences, Tehran, Iran.

Patients and Methods: This cross-sectional study was performed on 596 eyes from 298 students residing in dormitories of Iran University of Medical Sciences, Tehran, Iran, (157 males, 141 females) in the age range of 18-29 years from 2014 to 2015. The amplitude of accommodation for each participant in this study was assessed by the Donders' push-up method. Then, the minimum level of normal accommodative amplitude adjusted for the participants' age was calculated using the Hofshetter formula ($15 - 0.25 \times$ age) and the prevalence of adaptive insufficiency was calculated by comparing these two numbers for each participant.

Results: The mean accommodative amplitude was 12.86 diopters for all participants. The prevalence of accommodative insufficiency in the studied population measured using Donders' push-up method and evaluated based on Hofshetter formula was 4.5 %. There was a statistically significant difference between the male and female participants regarding the prevalence of accommodative insufficiency with 4.1 percent of males and 7.25 percent of females showing accommodative insufficiency.

Conclusion: The prevalence of accommodative insufficiency was comparable in our population to previous studies. A higher prevalence of accommodative insufficiency was observed among female participants.

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Introduction

A process in which the refractive power of the eye changes to maintain a clear image on the retina is known as accomodation [1]. This change in refractive power allows the retina to be in conjunction with different distances [1]. The primary driver for accomodation is retinal blur. Color errors, spherical errors, astigmatism, and vergence are also recognized as less important stimuli [2].

Accomodative insufficiency is one of accomodative disorders and happens when the amplitude of accomodation is significantly lower than the expected amount for a given age [3]. Accomodative insufficiency is very similar to presbiopia, except that in elderly patients with presbiopia, the range of accomodation is within the predicted value for their age, while in people with accomodative insufficiency the range of accomodation is less than expected range for their age [3].

The cause of accommodative insufficiency is usually unknown, but it can be caused by systemic conditions such as Type 2 diabetes and multiple schlerosis [4,5]. Other probable causes include amblyopia, uveitis, anemia, physical exhaustion, myasthenia gravis, vergence insufficiency, trauma, malnutrition, and chronic alcoholism [4,5]. The prognosis is good for improving symptoms related to accommodative insufficiency; however, recurrence is common [6]. Symptoms of accommodative insufficiency may include blurred vision, headache, eye fatigue, drowsiness, loss of reading comprehension with movement, feeling dull around the eyes, double vision, inability to perform close tasks, loss of focus, and irritability [6]. Symptoms are likely to be exacerbated by close tasks, while the onset of symptoms may be gradual or sudden and the severity of symptoms varies between individuals [4,5]. These symptoms often have a negative impact on academic performance [7]. Multiple studies have been conducted on the prevalence of accommodative insufficiency among populations in different contreis [7-14], but there is a limited number of studies regarding this subject in Iranian population [15]. In the present study, the prevalence of accommodative insufficiency was evaluated among students from an Iranian higher education institute (Iran University of Medical Sciences, Tehran, Iran).

Patients and Methods

This cross-sectional study was performed on 596 eyes from 298 students residing in dormitories of Iran University of Medical Sciences, Tehran, Iran from 2014 to 2015. The study was approved by institutional ethics committee of Iran University of Medical Sciences and all participants gave their informed consent before entering the study. Students who had strabismus or a history of surgery to correct strabismus, amblyopia, nystagmus, cataracts, corneal and retinal damage or a vertical deviation of more than 1 Δ were excluded from the study. Also female participants in their menstrual period were excluded.

All participants underwent retinoscopy and ophthalmoscopy exams. The best visual acuity was measured using a Snellen chart and all participants performed a cover test. The amplitude of accommodation for both eyes of each individual was measured using

the Donders' push-up method with the Royal Air Force (RAF) rule starting with the right eye and then the left eye. To improve testing reliability, the measurement was repeated three times, and the average of the three measurements was recorded as the final reading. This reading was then converted to the amplitude of accommodation in diopters. Our criterion for detecting accomodative insufficiency was a reading of 2 diopters below the minimum accomodative amplitude suggested for the individuals' age using the Hofschaft formula ($15 - 0.25 \times$ age).

To analyze the data we used SPSS software version 20 (Armonk, NY: IBM Corp). P values less than 0.05 were considered statistically significant.

Results

This cross-sectional study was performed on 596 eyes of 298 participants (157 males, 141 females). The age range of of participants was 18-29 years. The mean accommodative amplitude was 12.86 diopters for all participants. The highest accommodative amplitude value (25 diopters) was observed in two individuals (one female and one male) and the lowest accommodative amplitude value (3.33 diopters) was observed in a male student. In total 33 participants including 7 males and 10 females suffered from accommodative insufeiciency. The prevalence of accommodative insufeiciency in the general population was 5.7 % and in males and females it was 4.5 % and 7.1 %, respectively (Figure 1), indicating a statistically significant

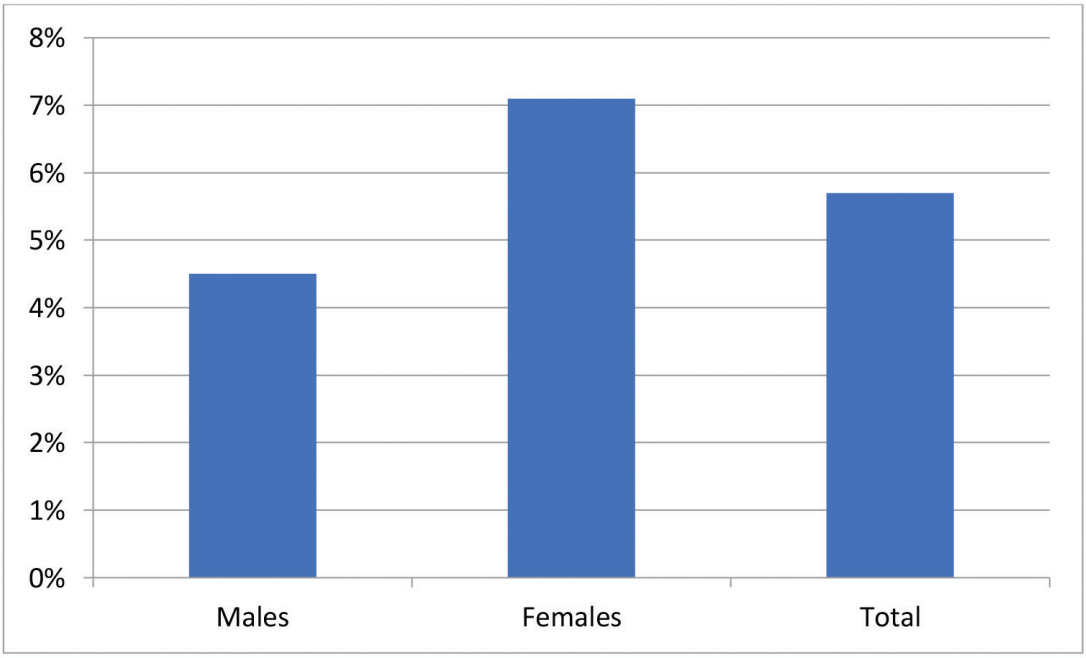

Figure 1 The mean calculated accommodation among total population as well as male and female participants

higher prevalence of accommodative insufficiency among female participants compared to male participants ($P < 0.05$). Twenty one persent of patients with accommodative insufeiciency had monocular insufeiciency and the rest of them had binocular insufeiciency.

Discussion

In the present study the prevalence of accommodative insufeiciency in the studeid population was 5.7 %. It was 4.5 % and 7.1 % among the male and female participants respectively ($P < 0.05$). In a study by Hoseini-Yazdi et al., [15] from Mashhad, Iran, the prevalence of accomodation insufficiency was 2.4 % in the total population. Wajuihian and Hansraj [16] in a study including 1,211 children (481 male and 730 female), with the age range of 13 to 19 years reported a prevalence of 4.5 % for accommodative insufficiency. García-Muñoz et al., [17] in a cross-sectional study conducted on a randomised sample of 175 university students aged between 18 and 35 years reported a prevalence of 2.28 % for accommodative insuficiencey. Jang and Park [18] assessed the prevalence of nonstrabismic accommodative and vergence dysfunctions among primary school children in a rural area of South Korea. In their study among 589 participants the prevalence of accommodative insufficiency was 5.3 % [18]. The difference in prevalence of accommodative incuficiency found by different authors could be due to the characteristics of the population under study and the diagnostic criteria used. In the present study our criterion for detecting accomodative insufficiency was a reading of 2 diopters below the minimum accomodative amplitude suggested for the individuals' age using the Hofschaft formula ($15 - 0.25 \times$ age) [19]. However, different authors have used different diagnostic criteria for detecting this disorder in their studeis. For example similar to the present study Daum et al., [20] used 2 diopters below the minimum accommodative amplitude calculated using Hofschmer's formula as their criteria for diagnosing a patient with accomodative insufficiency. Dwyer [21] and Stefania et al., [22] have not provided their specific diagnostic criteria and others, such as Abdul Kabir et al., [23] have used 2 diopters below the Donder's age expected value. Some other authors have combined one additional clinical finding with Hofschaft formula to discover accommodative insuffeiciency, like positive relative matching in the study by Hokoda [24] and lag in monocular estimated method retinoscopy in the study by Rouse et al., [25]. Other authors have also used a combination of Hofstetter's formula and one or more other clinical readings [12,13, 26]. Also the heterogeneity of the sample populations used in different studies makes it difficult to compare their findings. Evaluation of binocular and adaptive disorders has been performed in adult and pediatric populations. In young children, the subjective response to tests may not be as reliable as adults. Also natural selection may have an affect on prevalence meaning that children with accommodative insufficiency might have gradually dropped out of school resulting in less prevalence in adult student population attending higher education compared to children.

Conclusion

The prevalence of accommodative insufficiency was comparable in our population to previous studies. A higher prevalence of accommodative insufficiency was observed among female participants.

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Footnotes and Financial Disclosures

Conflict of Interest:

The authors have no conflict of interest with the subject matter of the present study.