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Relation Between Near Work and Myopia Progression in Student Population

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ABSTRACT

Aim To determine relation between near work and myopia progression in student population. Causes of myopia occurrence are not sufficiently explained. **Methods** This retrospective-prospective, descriptive research included 100 students with verified myopia up to -3 Dsph. Ophthalmological examination and measurement diopter-hours variable (Dh) were done twice, in the period from January 2011 until January 2012. **Results** A multivariate regression analysis of impact on the difference of distance visual acuity without correction to the right and left eye and difference of automatic computer refractometry in cycloplegia of both eyes indicates that, diopter-hours variable (Dh) had statistically significant impact on increase of distance visual acuity difference (right eye OR: I measurement–Dh 1.489, II measurement–Dh 1.544, $p<0.05$; left eye OR: I measurement–Dh 1.602, II measurement–Dh 1.538, $p<0.05$) and automatic computer refractometry in cycloplegia (right eye OR: I measurement 1.361, II measurement 1.493, $p<0.05$; left eye OR: I measurement 0.931, II measurement 1.019, $p<0.05$) during both measurements. **Conclusion** Near work cause the increase of myopia. This research opened a perspective for other researches on the impact of near work on myopia.

Key words: ophthalmological examination, diopter-hours variable (Dh).

1. INTRODUCTION

Myopia is a refractional anomaly where the parallel rays coming from the distance, following the refraction through the cornea and the lens, focus before retina in the vitreous humour and by coming before the focus in divergence state, they create dispersive circles on retina with blurry image of the subject that is located in infinity (1). Causes of myopia have not been sufficiently ascertained (2). There are several issues elaborated as the cause of myopia, such as heredity, malnutrition, obesity, endocrine disorders, chemical deficits (calcium, vitamin deficit), excessive or insufficient use of glasses, excess during near-sighted activities (2, 3). Most frequent theories relating to hereditary and environmental factors, working conditions and near-sighted work, as well as their combinations were established before (1, 2).

Near work and appropriate accommodation are key factors for development and progression of myopia. The relation between myopia progression and the time spent in reading and near work was determined as well as between myopia and reading distance (4, 5, 6). It was established that near work (especially reading), as well as better school grades and educational level, are possible risk factors for myopia with students (4, 7, 8, 9).

It is assumed that near work and exposure to artificial light during childhood present environmental factors of risk for the occurrence and development of myopia. Former studies have shown the relation between the amount of myopia and educational level (4, 7, 10).

The aim of this research was to identify the relation between near work and progressive myopia in student population. Previous studies found that near work has a effect on the development and progression of myopia in university students (11-18). So far similar research has not been done in Bosnia and Herzegovina and in this region.

2. PATIENTS AND METHODS

The study included 100 students of the University of Zenica, of both genders, 18 to 25 years of age with confirmed myopia up to–3 Dsph prior to entering the faculty, where an optical correction as well as the absence of general, systemic diseases in the course of research were determined. In addition to myopia up to -3 Dsph, depending on established diagnosis, exclusion criteria were an existence of any other eye disease as well as any eye surgery. Examinees voluntarily participated in the study which was confirmed following detailed information on the purpose and manner of implementing the research by signing

		Mean	N	SD	SEM	t	p
Pair 1	I measurement – automatic computer refractometry in cycloplegia of the right eye (Dsph)	-1.327	100	0.611	0.061	6.394	0.0001
	II measurement – automatic computer refractometry in cycloplegia of the right eye (Dsph)	-1.455	100	0.642	0.064		
Pair 2	I measurement – automatic computer refractometry in cycloplegia of the left eye (Dsph)	-1.287	100	0.636	0.063	4.387	0.0001
	II measurement – automatic computer refractometry in cycloplegia of the left eye (Dsph)	-1.402	100	0.693	0.069		

Table 1. First (I) and second (II)measurement of automatic computer refractometry in cycloplegia of the right and left eye. N, total number of samples; SD, standard deviation; SEM, standard arithmetic mean error; t, student's t-test

the consent on participation in the study. The protocol of this study complies with principles of the Declaration of Helsinki. A consent of the Ethics Committee of the School of Medicine, Sarajevo University, has also been obtained.

The study was retrospectively-prospective, descriptive and implemented in the period between the beginning of January 2011 until the end of January 2012. Ophthalmological examination and the time spent during near work was established with the diopter-hours variable (Dh) were done.

Ophthalmological examination was done in the Ophthalmology Office of the Institute for Occupational and Sports Medicine of the Zenica-Doboj Canton, twice during academic years 2010/11 and 2011/12, at the end of the winter semester 2010/11 and at the end of the winter semester 2011/12. It included determining of distance visual acuity without correction, biomicroscopic examination of the front eye segment, determining of refraction at cycloplegia and finding at the ocular fundus.

		Difference I and II - (Dsph) - O.D.	Difference I and II - (Dsph) - O.S.	I measurement - Diopter-hours variable (Dh)	II measurement - Diopter-hours variable (Dh)	Age
Difference I and II - V.O.D.	Rho	0.807*	0.542*	0.071	-0.078	-0.088
	p	0.000	0.000	0.480	0.441	0.386
Difference I and II - V.O.S.	Rho	0.706*	0.595*	0.174	0.027	-0.051
	p	0.000	0.000	0.084	0.789	0.614
Difference I and II - (Dsph) - O.D.	Rho		0.683*	-0.014	-0.168	-0.031
	p		0.000	0.886	0.095	0.763
Difference I and II - (Dsph) - O.S.	Rho			-0.017	-0.130	0.058
	p			0.865	0.199	0.570

*Table 2. Correlation between differences of the first (I) and second (II) measurement. *Correlation significant on the level p<0.01; Rho, Pearson's correlation; V.O.D., distance visual acuity without correction of the right eye; V.O.S., distance visual acuity without correction of the left eye; O.D., automatic computer refractometry in cycloplegia of the right eye; O.S., automatic computer refractometry in cycloplegia of the left eye*

During examination, examinees completed questionnaires containing: general data, their average time spent on reading, reading for pleasure (newspapers, magazines, books), playing video games or work on computer at home and watching television.

The time spent during near work was established with the diopter-hours variables (Dh) that was determined based on the following formula:

Dh = 3x (hours spent in learning + hours spent in reading for pleasure) + 2x (hours spent in playing video games or working on computer at home) + 1x (hours spent in watching television)

The time spent during near work excluded the time spent in near work at the faculty (working on computer, learning, reading after the class).

Data were processed by applying descriptive statistics, t-tests for independent samples, chi-square test, Pearson's test of linear correlation and multivariate regression analysis. The p<0.05 was considered as statistically significant.

3. RESULTS

There were more female, 61 (61%) in relation to male, 39 (39%) examinees. An average examinees age was 21.89±1.49 years (ranged from 20-25). The comparison of distance visual acuity without correction of the right eye indicates that in case of the first measurement it was 0.5224±0.3, and in case of the second measurement, 0.4746±0.3 (p<0.05). A distance visual acuity without correction of the left eye in case of first measurement was 0.5389±0.3, and in the second measurement 0.4865±0.3 (p<0.05).

Automatic computer refractometry in cycloplegia of the right eye in the first measurement was -1.3275±0.61 Dsph and in second one was -1.455±0.64 Dsph (p<0.05). Automatic computer refractometry in cycloplegia of the left eye in the first measurement was -1.2875±0.64 Dsph, and in the second one it was -1.4025±0.69 Dsph (p<0.05) (Table 1).

The analysis of average time spent in learning indicates that examinees learned shorter during the first measurement (21.57±7.5 hrs) in relation to the second one (22.51±6.9 hrs) along with statistically significant differences between the first and second measurement. The comparison of time spent in reading for pleasure does not show statistically significant differences between measurements; during the first measurement, examinees spent 10.26±5.1 hours in this activity but during the second measurement, 10.06±4.2 hours. The analysis of average time working on computer indicates that during the second measurement, examinees worked shorter (12.98±6.182 hrs) in

Coefficient*							
Model	Non-standardized		Standardized	t	p	95.0% confidence interval B	
	B	Std. error	Beta			Lower	Upper
(Constant) **Right eye**	0.070	0.070		1.000	0.320	-0.069	0.208
I measurement - Diopter-hours variable (Dh)	0.004	0.001	1.489	5.152	0.000	0.002	0.005
II measurement - Diopter-hours variable (Dh)	0.004	0.001	1.544	5.377	0.000	0.006	0.003
(Constant) **Left eye**	0.022	0.069		0.309	0.758	-0.117	0.160
I measurement - Diopter-hours variable (Dh)	0.004	0.001	1.602	5.405	0.000	0.002	0.005
II measurement - Diopter-hours variable (Dh)	0.004	0.001	1.538	5.220	0.000	0.006	0.003

*Table 3. Multivariate regression analysis of impact on the difference of distance visual acuity without correction of the right and left eye. *Dependent variable: I and II measurement difference of distance visual acuity without correction of the right and left eye. B, results of regressional analysis; Beta, probability ratio (odds ratio); t, the student's t-test*

Coefficient*							
Model	Non-standardized		Standardized	t	p	95,0% confidence interval B	
	B	Std. error	Beta			Lower	Upper
(Constant) **Right eye**	0.152	0.162		0.943	0.348	-0.169	0.473
I measurement - Diopter-hours variable (Dh)	0.008	0.002	1.361	4.991	0.000	0.005	0.012
II measurement - Diopter-hours variable (Dh)	0.010	0.002	1.493	5.508	0.000	0.007	0.014
(Constant) **Left eye**	0.022	0.069		0.309	0.758	-0.117	0.160
I measurement - Diopter-hours variable (Dh)	0.007	0.003	0.931	2.905	0.005	0.002	0.013
II measurement - Diopter-hours variable (Dh)	0.009	0.003	1.019	3.202	0.002	0.004	0.015

*Table 4. Multivariate regression analysis of impact on the difference of automatic computer refractometry in cycloplegia of the right and left eye. *Dependent variable: I and II measurement difference of distance visual acuity without correction of the right and left eye. B, results of regressional analysis; Beta, probability ratio (odds ratio); t, the student's t-test*

relation to the first measurement (14.36±6.843 hrs) with statistically significant differences between the first and second measurement. During the first measurement, examinees spent more time in watching television, 12.73±6.3 hours in comparison to the second measurement, 11.47±5.3 hours with statistically significant differences between measurements.

The comparison diopter-hours variable (Dh) during the first and second measurement indicates that its average value was higher during the first measurement and it amounted 137.01±32.8 in relation to the second measurement with average of 134.96±28.9 and statistically significant differences between measurements ($p<0,05$).

The analysis of correlation between differences of the first and second measurement of the distance visual acuity without correction to the right and left eye, automatic computer refractometry in cycloplegia of both eyes, and diopter-hours variable (Dh) indicates the following: a significant correlation was recorded only according to difference of automatic computer refractometry in cycloplegia of the right and left eye of the first and second measurement, indicating that myopia increased with a decrease of visual acuity (Table 2).

A multivariate regression analysis of impact on the difference of distance visual acuity without correction to the right and left eye and difference of automatic computer refractometry in cycloplegia of both eyes indicates that during both measurements, diopter-hours variable (Dh) had statistically significant impact on increase of distance visual acuity difference and automatic computer refractometry in cycloplegia between two measurements (Table 3,4).

4. DISCUSSION

With the development of civilization, there has been an increasing number of persons diagnosed with myopia (2, 3, 19). Distribution of myopia is diverse in different parts of the world. In the former Yugoslavia, according to Dorn, myopia occurred in 12% of residents (2).

The aim of this research was do determine the relation between near work and myopia progression.

In this research, by analyzing the correlation between distance visual acuity differences without correction, automatic computer refractometry in cycloplegia of both eyes and diopter-hours variable (Dh) of the first and second measurement, it was determined that increase of difference of automatic computer refractometry in cycloplegia of the first and second measurement lead to the increase of distance visual acuity without correction of both eyes during the first and second measurement, which was expected since the increase of myopia caused the decrease of distance visual acuity.

On grounds of multivariate regression analyses of impact to differences of distance visual acuity and automatic computer refractometry in cycloplegia of both eyes, it was determined that near work, determined under diopter-hours variable (Dh), causes the decrease of distance visual acuity, that is, progression of myopia.

This research identified that near work increases myopia in case of examinees. Therefore, it can be concluded that near work has unfavorable impact on myopia deterioration.

This research included more female examinees in relation to male ones. However, this result, considering the amount of samples cannot be relevant for a conclusion that myopia is more frequent in female students. Other research established that myopia is more frequent in females than males. Richler and Bear in Newfoundland study also determined greater prevalence of myopia in females than males (18), which was determined by Angle and Wissmann (19), as well as Goldschmidt (20). Pärssinen and Lyyra in case of Finnish children determined that myopia was more frequent with girls because boys spent more time in sport activities (21), which was identified by Lu et al in

Chinese children and youth, since girls spent more time reading and doing homework than boys, who spent more time in activities at open space (22). The same was identified by French et al. in school children in Sydney (23) as well as You et al in Chinese youth (24).

Near work presents the key factor for beginning and deterioration of myopia. The relation between myopia progression and time spent in reading and near work, also between myopia and reading distance was established. In their research, Pärssinene et al (25), Saw et al (26), as well as Yingyong (27), determined that myopia progression is related to near work and short reading distance. Jacobsen et al (28) determined myopia progression in case of Danish medicine students who spend more time in learning and reading since intensive learning is a risk factor for occurrence and progression of myopia which as also determined by Kinge et al (29) in a three-year study in case of Norwegian students of technical sciences. Ip et al so determined that near work impacts myopia progression but also the fact that near work intensity is more significant for myopia progression than the entire time spent during near work (30). Kinge et al determined that only reading has the impact on myopia progression whereas working on computer and watching TV has no impact at all (29).

Results of this study and results of former studies indicate that near work plays an important role in development and progression of myopia. Long-term near work causes myopia progression.

It is necessary further research that would completely determine the significance of impact of near work on occurrence and increase of myopia is necessary as well as possibility and practical applications of new findings in everyday life of a contemporary man.

Conflict of interest: NONE DECLARED.

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