

Sex, Age and Blood Group Structure of Myopia and Astigmatism in South Bulgaria Population

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Abstract. Myopia and astigmatism are common visual abnormalities in human populations worldwide. The studies in Bulgaria concerning the population structure in context of these defects and their relations with sex, age, etc. metrics are limited. Reasonably the present study aims to analyze peculiarities in the manifestation of myopia and astigmatism by characterizing the sex, age and AB0 blood group structure of a reproductive population in southern Bulgaria. The study includes 817 individuals of both sexes, aged between 18 and 59 years. They voluntarily have filled out a questionnaire, giving diseases information (myopia and astigmatism), after they had been diagnosed by a physician. AB0-blood group affiliation has been determined in laboratory conditions by a routine technique. Based on the obtained results, it is concluded that female sex and age over 44 years are risk factors for manifestation of the studied refractive abnormalities, and blood groups A and 0 hide a greater risk for their joint manifestation.

Key words: myopia, astigmatism, sex, age, AB0 blood groups.

Introduction

Multifactorial diseases are an object of increased interest because of their complex etiology. Their manifestation depends on genetic and environmental factors such as sex, age, body composition, different social factors and habits (Nikolova & Petrov, 1982; 1986; Petrov et al., 1987; Nikolova, 1994; Baird et al., 2010; Nikolova & Boyadjiev, 2011; Tedja et al., 2019; Ivanova et al. 2021).

Refractive errors are widespread throughout the world. Myopia has a frequency varying between 1% and 10% in different human populations. Data indicate that pathological myopia annually causes blindness at an incidence of 1 to 5% (Asakuma et al., 2012; Pan et al., 2013). Astigmatism is another common visual

defect, usually reported at birth, and a marker for predisposition to other refractive errors (Mackey et al., 2011).

Different studies, provide information on the heritability pattern of astigmatism and pointed out its wider prevalence in specific ethnic groups (Harvey et al. 2010; Fan et al., 2011; McKean-Cowdin et al., 2011; Mackey et al., 2011; Lopes et al., 2013) and also variations by age and sex (Gudmundsdottir et al. 2000; Shih et al. 2004; Hashemi et al. 2005).

In Bulgaria, studies on the structural characterization of refractive errors are limited (Ivanova et al., 2018) and this motivates the conduct of the present study, which aims to analyze peculiarities in the manifestation of myopia and astigmatism by

characterizing the sex, age and AB0 blood group structure of reproductive population in southern Bulgaria.

Material and Methods

A total of 817 individuals (30.2% men and 69.8% women), aged between 18 and 59 years and divided into two age categories – up to and over 44 years – have been included in the present study. It has conducted within a five-year period, from 2017 to 2021. The individuals included in the study are all of Bulgarian ethnic origin, from settlements in the territory of the Plovdiv Region, Southern Bulgaria. The participants voluntarily and after obtained informed consent, have filled out a questionnaire, designed according to the objectives of the study, in which they indicated whether they suffered from certain multifactorial diseases, including myopia and astigmatism. Only cases diagnosed by a specialist physician are included in the analysis.

AB0 blood grouping has been determined in the laboratory conditions

using a routine technique of Moss or has been directly accepted after an official document provided by a clinical laboratory. The software package IBM SPSS Statistics, version 22.0 has used for statistical analysis of the reported results.

Results

Sex. The results regarding distribution of myopia and astigmatism, according to sex are presented in Table 1. As could be seen, 30.6% of female and 22.7% of male have myopia, and 24.7% of female and 16.5% of male – astigmatism. The established differences, regarding both diseases are statistically significant ($p = 0.030$, $\chi^2 = 4.700$ and $p = 0.014$, $\chi^2 = 6.038$ respectively).

Table 2 presents results, regarding simultaneous reporting of both visual abnormalities, depending on sex. It becomes clear, that such a joint manifestation is presented in a high percentage of the studied individuals – 33.3% for men, and twice higher for women – 66.7%. The established difference is distinct and statistically significant ($p < 0.001$, $\chi^2 = 14.344$).

Table 1. Myopia and astigmatism – distribution by sex ($p \leq 0.03$). *Legend:* N – Number of individuals, % - percentage; (+) presence of disease; (-) absence of disease.

Sex	N %	Myopia			Astigmatism		
		+	-	Total	+	-	Total
Male	N	50	170	220	37	187	224
	%	22.7	77.3	100.0	16.5	83.5	100.0
Female	N	159	361	520	130	397	527
	%	30.6	69.4	100.0	24.7	75.3	100.0
Total	N	209	531	740	167	584	751
	%	28.2	71.8	100.0	22.2	77.8	100.0

Table 2. Myopia and astigmatism – simultaneous manifestation in dependence to sex ($p < 0.001$). *Legend:* N – Number of individuals, % - percentage; (+) presence of disease; (-) absence of disease.

Myopia and astigmatism		Sex	
		Male	Female
-	N	78	284
	%	21.5	78.5
+	N	167	334
	%	33.3	66.7

Age. The distribution of participants who suffer from myopia and astigmatism, according to sex and age, shows distinct differences. The results indicate that among the age group up to 44 years, both myopia and astigmatism occur with greater frequency in women - 28.2% and 24%, respectively, than in men - 20.7% and 14.6%, respectively. For both diseases, the reported differences are statistically significant: $p = 0.050$, $\chi^2 = 3.827$ for myopia and $p = 0.008$, $\chi^2 = 7.121$ for astigmatism - Table 3.

A comparison of older participants of both sexes, also demonstrate that myopia manifests in a higher percentage for females (43.8%), compared to males (33.3%). It is important to note that, despite the lack of a categorical statistical significance, the proportion of females with myopia is approximately 10% higher than that for males ($p = 0.290$, $\chi^2 = 1.118$).

The results of the present study show that in the age category over 44, astigmatism manifests with a similar

frequency within representatives of both sexes - 28.4% among women and 28.1% among men ($p = 0.977$, $\chi^2 = 0.001$) - Table 3.

Blood group affiliation. Table 4 presents data on the distribution of study participants, depending on their AB0 blood group type.

Myopia occurs more often in persons with blood groups B (31.3%) and AB (31.1%), and least often - in those with blood group 0 (27.7%). Astigmatism occurs with a similar frequency - 20.3% for blood group 0 to 24.8% - for blood group A. The established differences between the compared categories are not statistically significant ($p = 0.475$, $\chi^2 = 0.511$ for myopia and $p = 0.712$, $\chi^2 = 0.136$ for astigmatism).

The results of the present study show that the two visual abnormalities occur together in part of the studied individuals, from all four blood groups ($p = 0.358$, $\chi^2 = 0.846$). The highest number is found for the participants with myopia and astigmatism, who belong to blood groups A (36.3%) and 0 (32%) - Table 5.

Table 3. Myopia and astigmatism - age structure in the representatives of both sexes ($p \leq 0.05$). *Legend:* N - Number of individuals, % - percentage; (+) presence of disease; (-) absence of disease.

Age groups	Sex	Number	Myopia		Astigmatism	
			+	-	+	-
Up to 44	Male	N	38	146	28	164
		%	20.7	79.3	14.6	85.4
	Female	N	124	316	107	339
		%	28.2	71.8	24.0	76.0
	Total	N	162	462	135	503
		%	26.0	74.0	21.2	78.8
Over 44	Male	N	12	24	9	23
		%	33.3	66.7	28.1	71.9
	Female	N	35	45	23	58
		%	43.8	56.3	28.4	71.6
	Total	N	47	69	32	81
		%	40.5	59.5	28.3	71.7

Table 4. Myopia and astigmatism – distribution depending on AB0 blood group affiliation ($p > 0.4$). *Legend:* N – Number of individuals, % – percentage; (+) presence of disease; (-) absence of disease.

AB0 blood group	Number %	Myopia			Astigmatism		
		+	-	Total	+	-	Total
0	N	56	146	202	42	165	207
	%	27.7	72.3	100.0	20.3	79.7	100.0
A	N	74	172	246	63	191	254
	%	30.1	69.9	100.0	24.8	75.2	100.0
B	N	40	88	128	29	100	129
	%	31.3	68.8	100.0	22.5	77.5	100.0
AB	N	28	62	90	21	73	94
	%	31.1	68.9	100.0	22.3	77.7	100.0
Total	N	198	468	666	155	529	684
	%	29.7	70.3	100.0	22.7	77.3	100.0

Table 5. Myopia and astigmatism – simultaneous manifestation in dependence to AB0 blood group affiliation ($p > 0.3$). *Legend:* N – Number of individuals, % – percentage; (+) joint manifestation of diseases; (-) absence of disease.

Myopia and astigmatism		AB0 Blood group			
		0	A	B	AB
-	N	79	113	58	40
	%	27.2	39.0	20.0	13.8
+	N	126	143	72	53
	%	32.0	36.3	18.3	13.5
Total	N	205	256	130	93
	%	30.0	37.4	19.0	13.6

Discussion

Visual abnormalities are defined under the general name of "refractive errors" and often appear together. People who have astigmatism are prone to myopia or hyperopia (Sanil et al., 2018), which is also proven from the results of the present study.

Literature data show that in East Asia (China, Japan, Republic of Korea and Singapore) myopia has a higher occurrence – approximately 50% among the population, compared to Australia, Europe, North and South America, where its prevalence is relatively rarer (Holden et al., 2016). It is also reported a frequency of 36.4% of myopia among 8-years old children in Taiwan and China in 2016, while its

prevalence among 6-year-old children in Netherlands was only 2.4% for 2018 (Hsu et al., 2016; Tideman et al., 2018).

According to Sanil et al. (2018), the frequency of the disease in a similar age range (35.5 – 37.0 years) is approximately the same for both sexes, which is not confirmed by the results from our study, showing a predominant occurrence for the female sex. A series of studies have demonstrated that myopia is most common at school age and its prevalence decreases with increasing age (Leung et al., 2012; Sanfilippo et al., 2015; Natung et al., 2017; Gomez-Salazar et al., 2017). In our study, the data indicate that the frequency of this abnormality is lower in the age category up

to 44 years and significantly higher in the age group over 44 years, a trend, valid for both sexes (Table 3).

Regarding astigmatism, the literature reports that its prevalence increases significantly with age (Wong et al., 2000; Saw et al., 2002), being most significant in adults over 40 years (Saw et al., 2002; Bourne et al., 2004; Hashemi et al., 2005). Such a tendency, very clearly manifested in men, can be confirmed by the data of our study - Table 3. Pontikos et al. (2019) find negative associations of astigmatism with earlier age and female sex. The results of other researchers (Gudmundsdottir, 2000; Leung, 2012; Gomez-Salazar, 2017) demonstrate the association of the astigmatism with the male sex and the increasing age. In our study, a higher frequency of astigmatism is found among women aged up to 44 years and a similar frequency of occurrence of the anomaly among representatives of both sexes in the age category over 44 years (Table 3).

Some authors report that astigmatism usually occurs together with myopia and hyperopia at a later age (Farbrother et al., 2004). According to Sanil et al. (2018), its prevalence is approximately equal in men and women at an age of about 35 years, increases toward the age of 65 - 69 years, and then, above 70 years there is a plateau, with a large percentage of people with astigmatism (64%) who also have myopia. The results of our study confirm that the frequency of the abnormality increases with age and that there is a significant percentage of individuals suffering from both refractive errors.

Regarding the blood group affiliation of individuals suffering from myopia and astigmatism no significant differences were found and the simultaneous manifestation of the two refractive anomalies is more common in the blood groups A and 0. According to other authors, blood group B predominates among patients with myopia (Garg and Pahwa, 1965; Seth and Chahal,

2004; Gupta and Nishi, 2013; Sonal et al., 2020). We found no information regarding astigmatism and any blood group affiliation reported.

Conclusions

Based on the results of the present study, we could conclude that: 1) the female sex and the age over 44 years are risk factors for myopia and astigmatism; 2) the blood groups A and 0 hold a greater risk for their joint expression.

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