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MEDICINE

PHARMACY

RISK FACTORS FOR THE DEVELOPMENT OF ACQUIRED MYOPIA IN CHILDREN

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Abstract. *The article we present the results of a factor analysis of the development of acquired myopia in children. Data of 80 children (160 eyes) with acquired myopia of weak degree and 20 children (40 eyes) without ophthalmic pathology were analysed. The conducted factor analysis revealed 3 main factors that were designated as an «anatomically-constitutional» (48.9 % of the total dispersion), "hereditary" (7.6 % of the total dispersion) and "morphometric" (7.1 % of the total dispersion). It was established that the factor load of more than 0.7 was introduced by the variables of corneal refractive force (-0.882), axial eye length (-0.765), corneal curvature radius (0.748), corneal diameter (0.827), reserve of relative accomodation (-0.721), as well as the stage of connective tissue dysplasia (0,810). The factor load of heredity variable was (0.817), the factor load of the variable of peripapillary layer of nerve fibers was (-0.855). The obtained factor analysis data can be used in individual prediction of the probability of development of myopia in children.*

Keywords: *myopia, risk factors, development, factor analysis, children*

Relevance. The current problem of ophthalmology is the early development of acquired myopia in childhood. Despite the possibility of early diagnosis of this pathology with the help of modern methods and preventive measures, the number of children of pre-school age and early school-age with myopia continues to grow. It is known that 6-8 % of the students in the junior class already have a myopia, and by the end of the school the number of such children is increased to 34.3 % [11].

Among the factors that increase the risk of myopia there are the child prematurely, the heredity of the disease, early onset of education, short time of air activity, the introduction of computer technology into the educational process[2,5,7]. According to literature, ophthalmologic factors, such as disturbance of accommodation, decrease of the strong properties of the fibrous skin of the eye, play an important role in the pathogenesis of myopia development [1]. A number of studies have confirmed that a significant role in the development of myopia is played by the somatic pathology, namely, the presence of the syndrome of undifferentiated connective tissue dysplasia (SUCTD) [10,13]. So, taking into account the multifactorial nature of the mechanisms of myopia formation, it is relevant to conduct factor analysis, which allows to reduce the number of variables, to reduce them to independent factors, to rank by the degree of influence on the occurrence of acquired myopia.

Aim of the research - to determine the risk factors for the development of acquired myopia in children and to investigate their factor structure.

Materials and methods. 80 children (160 eyes) aged 7 to 12 years with a weak degree of myopia were examined. Visual acuity with correction for all children was 1.0. The observation time was 12-15 months. Also, 20 children (40 eyes) without ophthalmologic pathology were examined.

Standard ophthalmologic examination included: visometry, determination of the accommodation function of the eye, autorefractoceratometry (HUVITZ, HRK-7000) before and after cycloplegia, biomicroscopy, ophthalmoscopy, optical biometrics using the device (IOL Master 500 Karl Zeiss, Germany), examination using analyser of biomechanical properties of the eye (Ocular Response Analyzer (ORA), optical coherent tomography (Cirrus HD OCT 4000). The children's examination included a careful collection of anamnesis of life and disease, the determination of the phenotypic features of SUCTD and the degree of dysplasia, as well as the analysis of medical card data [8]. The phenotypic features of SUCTD were detected in 55 children with myopia and in 11 children without ophthalmologic pathology.

The selection of prognostically significant factors in the onset of acquired myopia was carried out using ROC analysis. The zero degree of prediction of the indicator was set at a plane under the ROC curve of 0.5 conventional units and less [9]. In order to detect as few as possible of the hidden general factors that are most likely to affect the progression of myopia, and their factor loadings, factor analysis was performed. The basis of modeling for the selection of factor systems we chose Spirman correlation matrix with the subsequent determination of the vector load of the studied indicators. Significant factors in the model were investigated using the "rocky oscillation" criterion and the Kaiser criterion. For the sampling of

indicators with high factor load on the complex (more than 0.7), we used the VARIMAX orthogonal rotation method. Factor analysis using VARIMAX rotation is based on the results of initial analysis and use for describing the dispersion of the data array the main components [12].

Statistical processing of the obtained results we carried out on a personal computer in the program "STATISTICA 6.0" (StatSoftInc., License No. AXXR712D833214FAN5), as well as "SPSS 15.0." For all types of analysis statistically significant differences were considered at $p < 0,05$.

Results and its discussion. According to the results of ROC analysis, 16 potential predictors of myopia progression were selected, which included anamnestic data, indicators of the state of the visual analyzer (according to the ophthalmologic review), phenotypic signs of connective tissue dysplasia. The conducted Spirman rank correlation analysis established the existence of certain interrelationships between ophthalmologic indicators and signs of connective tissue dysplasia.

Thus, the correlation between the degree of connective tissue dysplasia and the anatomical and optical indicators of the eye, namely, the corneal refractive power ($r = -0.68$, $p < 0.05$), axial eye length ($r = 0.58$, $p < 0.05$), the radius of curvature ($r = 0.71$, $p < 0.05$) and corneal diameter ($r = 0.77$, $p < 0.05$), depth of the anterior chamber of the eye ($r = -0.45$, $p < 0.05$), corneal hysteresis ($r = -0.49$, $p < 0.49$), thickness of the peripapillary layer of nerve fibers ($r = -0.35$, $p < 0.05$). The correlation between the degree of connective tissue dysplasia and the reserve of relative accommodation ($r = -0.79$, $p < 0.05$), as well as reserve of absolute accommodation ($r = -0.67$, $p < 0.05$) was established. In children who has complicated myopia heredity, there was a relationship with the degree of connective tissue dysplasia ($r = 0.39$, $p < 0.05$). The biggest correlation of phenotypic manifestations of SUCTD is observed between the hypermobility of the joints and heredity ($r = 0.37$, $p < 0.05$).

For a more detailed consideration of the relationships and the identification of the factors that mostly affect the development of myopia in children and factor load, the correlation matrix indicators were subjected to factor analysis. The conducted factor analysis showed that the course of myopia is determined by the three most significant factors which have their own values greater than 1 and explain 64.5 % of the total dispersion (Table 1).

Table 1. Risk factors of the development of acquired myopia and their factor load

Variable	Factor load		
	Factor 1	Factor 2	Factor 3
Refractive corneal force	-0,882*	-0,017	-0,042
Axial length of the eye	0,765*	-0,012	0,113
Corneal hysteresis	-0,372	-0,288	-0,541
Thickness of the layer of peripapillary nerve fibers	-0,167	-0,014	-0,855*
Depth of the anterior chamber of the eye	0,400	0,355	0,343
The radius of curvature of the cornea	0,748*	0,062	0,397
Diameter of the cornea	0,827*	0,154	0,264
Reserve of relative accommodation	-0,722*	-0,313	-0,292
Reserve of absolute accommodation	-0,642	0,459	-0,047
Indicator of the usual tone of accommodation	0,527	0,175	-0,112
Degree of dysplasia	0,810*	0,389	0,221
Hypermobility of the joints	0,535	0,667	-0,087
Scoliosis, impaired posture	0,653	0,386	0,202
Asthenic figure	0,611	0,255	0,364
Heredity	-0,023	0,817*	0,135
The share of total dispersion, %	49,8	7,6	7,1

Note: * - statistically significant factor load ($p<0,05$)

The greatest significance due to the high load has the first factor that explains the largest percentage of total dispersion and covers 49.8 % variation. The greatest significance due to the high load is the first factor that explains the largest percentage of total dispersion and covers 49.8 % variation. Its components were varied and determined by the following variables with factor load: refractive corneal force (-0.882), axial length of the eye (-0.765), radius of curvature of the cornea (0.748), diameter of the cornea (0.827), reserve of relative accommodation (-0.721), in all cases $p < 0,05$. A high factor load on the complex was also an indicator of the degree of dysplasia with a factor load of 0.810 ($p < 0.05$). The first factor can be conventionally interpreted as "anatomically-constitutional".

The second most significant factor was characterized by only one variable - heredity, but with a rather high factor load of 0.817 ($p<0.05$). The total variance of the "hereditary" factor was 7.6 %.

The obtained data look logical, taking into account the fact that the peculiarities of the anatomical-optical parameters of the eye and their physiologically unfavourable relationship play one of the leading roles in the formation of myopia during refractogenesis [14]. The risk of myopia increases with the presence of moderate to severe connective tissue dysplasia in a child. In turn, in the case of syndrome of connective tissue dysplasia, there is a disruption of the metabolism of collagen structures in the connective tissue of the sclera, the collagen fibers of which weaken and this leads to an appropriate increase in the axial length of the eye [6]. The results of our factor analysis show that the decrease in the thickness of the layer of peripheral papillary nerve fibers are already occurring in the development of acquired myopia [3].

Violation of accommodation, namely the reduction of the reserve relative accommodation in relation to age standards is a prognostic sign of the development of myopia [1].

The effect of the "hereditary" factor on the onset of myopia does not call into question, since it is known that in children with myopia complicated with heredity, the percentage of manifestation of the disease is much greater than in its absence. In this case, all the components that determine the form and degree of refraction of one of the parents can be inherited: the length of the anterior-posterior axis of the eye, the refractive corneal force, the corneal curvature, the depth of the anterior chamber of the eye, the thickness of the lens [4].

Conclusions. The data obtained from the factor analysis are understandable for determining the leading predictors of acquired myopia in children, the formation of which occurs as a result of the interaction of a number of factors. The results of factor analysis showed that in the development of acquired myopia in children the main factors associated with the peculiarities of the anatomically-optical parameters of the eye, the state of accommodation, heredity are closely related to the manifestations of connective tissue dysplasia. The obtained data must be taken into account in individual prediction of the probability of developing myopia in children for the timely conduct of preventive measures.

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