HUMAN ECOLOGY

Effect of Medical and Biological Factors on Neurological Manifestations of Vertebral Osteochondrosis in Residents of the Southern Altai Mountains

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We performed clinical and epidemiological study of 1508 residents living in the southern Altai Mountains and belonging to two subethnic groups (Telengite and Altai Kizhi). The incidence of neurological manifestations of vertebral osteochondrosis in people older than 17 years was 627.6±26.4%. The results show that genetic factors (hereditary polygenic predisposition) play a major role in the development of neurological manifestations of vertebral osteochondrosis. Premorbid state of the organism and diseases of various organs and systems promote the development of this neurological disorder.

Key Words: *southern Altai ethnic group; medical and biological factors; vertebral osteochondrosis; neurological manifestations*

Neurological manifestations of vertebral osteochondrosis (NMVO) are of considerable medical and social significance [3,4,7,8,12]. The distribution and populational polymorphism of NMVO in various countries and regions and the role of climatic, geographic, geologic, ethnic, and other factors in the development of this disorder remain unclear. The populational approach holds much promise in this aspect [1,7,9-11]. Clinical and epidemiological studies in regions inhabited by native people attract much recent attention. One of these regions is the Southern Altai Mountains [2,5,6] inhabited by people of Southern Altai subethnic groups (Telengits and Altai Kizhis).

Previous studies showed that the incidence and clinical polymorphism of NMVO differ in residents of Altai and Slavs [7]. These data suggest that the genetic predisposition to NMVO is determined by medical and biological factors.

Here we studied the role of constitutional and acquired characteristics in the incidence of NMVO in residents of the Southern Altai Mountains.

MATERIALS AND METHODS

Examination was performed by clinical-and-epidemiological, anthropometric, general clinical, neurologic, clinical-and-genealogical, genetic-and-mathematic (segregation analysis and study of alternative and quasi-continuous phenotypic models for the hereditary predisposition to NMVO), and statistical methods.

We selected a random sample of Slavs, representative of the general population (n=16,689), 1508 residents of the Southern Altai, and 3761 people (324 families) whose probands had NMVO. There were 1736, 1310, and 391 relatives of degrees 1, 2, and 3, respectively.

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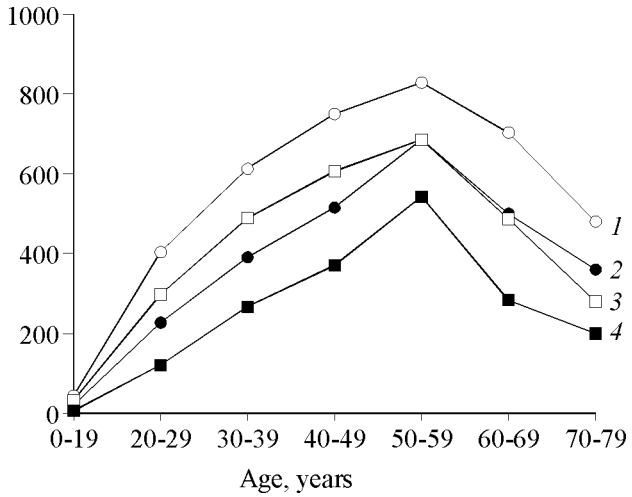

Fig. 1. Incidence of neurological manifestations of vertebral osteochondrosis depending on the age of patients: neurological manifestations of vertebral osteochondrosis (*1*), cervical osteochondrosis (*2*), lumbar osteochondrosis (*3*), and cervical and lumbar osteochondrosis (*4*).

The Southern Altai population included residents of 8 villages in the Southern Altai Mountains belonging to two subethnic groups (Telengite and Altai Kizhi). The Telengits live under uncomfortable high-mountain conditions (2000 m above sea level). The Altai Kizhis live in medium-mountain (1000 m) and low-mountain regions (500 m). We examined 1508 of 5307 residents living in 8 localities in the Southern Altai Mountains (956 women and 552 men, 28.4± 1.2% of the general population).

The history of epidemiological and clinical examination was standardized to unify data collection. The results were recorded in a database and subjected to computer statistical analysis.

RESULTS

We evaluated the role of genetic factors in the etiology of NMVO. The incidence of NMVO in Slavs (Russians, Belorussians, and Ukrainians) and Altaic people was compared (Table 1). The incidence of NMVO in residents of the Southern Altai Mountains was 1.5-fold higher than in Slavs. Neurological manifestations of cervical and multilevel osteochondrosis in Altaic people were more prevalent than in Slavs, but the prevalence of lumbar osteochondrosis in residents of the Altai Mountains was 2-fold lower than in Slavs (p_t<0.001). These differences were associated with ethnogenetic factors. The incidence of NMVO in Altai Kizhis surpassed that in Telengits (656.3±31.2 and 540.5± 49.3%, respectively, p_t<0.05).

Genetically determined factors, gender and age, play a role in the development of NMVO [3,4,7,12]. In residents of the Southern Altai and Slavs localization of NMVO depended on gender. Neurological manifestations of cervical (483.4 and 278.2%, respectively) and multilevel osteochondrosis (328.1 and 188.0%, respectively) in women were found more frequently than in men (p_t<0.05).

The incidence of NMVO of different localization increased with age, reached maximum at 50-59 years, and then remained unchanged (Fig. 1).

A positive correlation between the incidence of NMVO and neurological manifestations of cervical, lumbar, and multilevel osteochondrosis and age was strong in Telengits (r=0.85, 0.93, 0.78, and 0.90, respectively) and intermediate in Altai Kizhis (r=0.52, 0.56, 0.33, and 0.38, respectively). Significant differences were found in the incidence of NMVO in Telengits and Altai Kizhis of various ages (χ^2 test, p_{χ^2}<0.001).

Studies of the relationship between NMVO and age revealed differences between residents of the Southern Altai and Slavs. A positive correlation was found between the incidence of NMVO and age in Slavs. In these people the incidence of NMVO exponentially increased with age [7].

Genealogical studies showed that differences in the incidence of NMVO in relatives of degrees 1, 2, and 3 (p<0.001) were associated with the regression of common genes. It is typical of polygenic hereditary diseases (Fig. 2).

Our previous genetic and mathematic analysis showed that the NMVO phenotype is determined by the oligogenic megaphenic complementary system of interacting major megaphenic and modifying genes. The contribution of genetic and environmental factors

TABLE 1. Incidence of Neurological Manifestations of Vertebral Osteochondrosis with Different Localization in Altaics and Slavs Older 17 Years (%, $M\pm m$)

Phenotypic variant	Altaics	Slavs
Neurological manifestations of vertebral osteochondrosis	627.6±26.4	439.4±4.9
Neurological manifestations of cervical osteochondrosis	423.6±21.7	354.2±4.8
Neurological manifestations of lumbar osteochondrosis	490.5±23.4	873.5±3.3
Multilevel osteochondrosis	286.5±17.9	227.6±4.2

Note. p_t<0.001: differences between ethnic groups.

to the resistance to NMVO is 80 and 20%, respectively.

Constitutional factors reflecting genetically determined morphological adaptation of the organism to adverse conditions contribute to realization of the genetic predisposition to NMVO. Anthropometric study showed that most Telengits with NMVO were hypersthenic, but not asthenic (as compared to people without NMVO, Table 2). Body weight tended to increase in patients with NMVO ($p_{\chi^2}<0.05$, $\chi^2=0.025$). It was related to changes in bone, but not in adipose tissue, and depended on the type of nutrition that did not differ in people of the sample. Anthropometric characteristics were similar in Altai Kizhis with and without NMVO.

In patients with NMVO the signs of vestibular insufficiency were observed more frequently than in healthy individuals. Our results are consistent with published data on Slavic ethnic groups and confirm an important role of premorbid coordination deficit in the realization of NMVO [7].

We studied the relationship between genetic markers, incidence, and various parameters of NMVO. The incidence and clinical polymorphism of NMVO in residents of the Altai Mountains did not depend on the AB0 blood group system and functional asymmetry in nervous regulation of motor and sensory functions.

In people of Slavic ethnic groups NMVO signs of vestibular insufficiency and discoordination were observed more frequently than in healthy individuals [7].

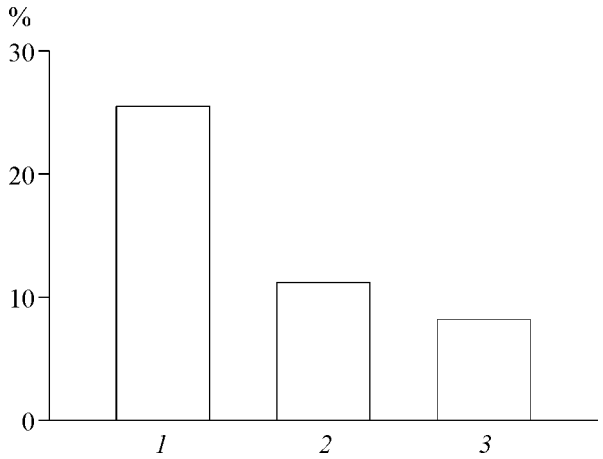

Fig. 2. Incidence (%) of recurrent neurological manifestations of vertebral osteochondrosis in families depending on the degree of relationship (*1*, *2*, *3*).

We performed a screening test with questionnaires, which yielded a tentative conclusion about these functions. Independently on the presence or absence of NMVO, one-thirds of people felt discomfort under vestibular load during childhood. In patients with NMVO the incidence of vestibular insufficiency was higher than in healthy individuals (56.0±3.5 and 38.9±2.6%, respectively, $p_t<0.001$). An intermediate correlation was revealed between test parameters (Spearman rank correlation test, $\rho=0.37$-0.46).

People of the Southern Altai ethnic group had a variety of diseases. The role of diseases of various organs and systems in the development of NMVO was

TABLE 2. Distribution of Patients in Ethnic Groups of Telengits and Altai Kizhis with and without Neurological Manifestations of Vertebral Osteochondrosis Depending on Anthropometric Characteristics (%, *M*±*m*)

Anthropometric characteristics	Telengits		Altai Kizhis		Both subethnic groups	
	with NMVO (*n*=80)	without NMVO (*n*=85)	with NMVO (*n*=301)	without NMVO (*n*=179)	with NMVO (*n*=381)	without NMVO (*n*=264)
Constitutional type						
Asthenic	23.8±4.7	35.3±5.2	23.9±2.5	31.8±3.5	23.9±2.2	33.0±2.9
Normosthenic	42.5±5.5	41.2±5.3	47.2±2.9	45.3±3.7	46.2±2.5	43.9±3.0
Hypersthenic	33.8±5.3	23.5±4.6	28.9±2.6	22.9±3.1	29.9±2.3	23.1±2.6
Sexual dimorphism						
Andromorphic	10.0±3.4	16.5±4.0	18.3±2.2	15.6±2.7	16.5±1.9	15.9±2.2
Mesomorphic	81.3±4.4	72.9±4.8	68.1±2.7	70.4±3.4	70.9±2.3	71.2±2.8
Gynecomorphic	8.8±3.2	10.6±3.3	13.6±1.9	14.0±2.6	12.6±1.7	12.9±2.1
Body weight, Ketle index*						
Low	12.1±1.7	16.3±2.3	12.5±3.7	17.6±4.1	12.0±1.9	15.6±2.7
Normal	50.7±2.6	53.8±3.1	60.0±5.5	64.7±5.2	48.2±2.9	48.6±3.7
High	37.3±2.5	29.9±2.8	27.5±4.9	17.6±4.1	39.9±2.8	35.8±3.6

Note. *Body weight by the Ketle index: low (<20), normal (20.00-24.99), and high (≥25).

TABLE 3. Incidence of Diseases of Various Organs and Systems in People of the Southern Altai Depending on the Presence or Absence of NMVO and Rank Correlation Coefficient between the Incidence of NMVO and Other Diseases (%, *M*±*m*)

Disease	Sample (*n*=1259)	People without NMVO (*n*=753)	Patients with NMVO (*n*=506)	Rank correlation coefficient, ρ
ENT diseases*	57.0±1.4	50.7±1.8	66.4±2.1	0.55
Endocrine diseases	51.0±1.4	51.0±1.8	51.0±2.2	0.45
Dentomaxillary diseases***	43.2±1.4	40.5±1.8	47.2±2.2	0.51
Gastrointestinal diseases*	33.3±1.3	28.0±1.6	40.5±2.2	0.49
Cardiovascular diseases*	32.2±1.3	22.3±1.5	46.8±2.2	0.51
Skin diseases**	25.0±1.2	21.8±1.5	29.8±2.0	0.53
Gynecological diseases*	20.1±1.4	15.9±1.7	26.2±2.3	0.60
Mental diseases*	18.7±1.1	13.9±1.3	25.7±1.9	0.51
Diseases of the lungs and pleura*	18.1±1.1	12.6±1.2	26.3±2.0	0.63
Iron deficiency anemia*	16.6±1.0	12.7±1.2	22.3±1.9	0.62

Note. *p<0.001, **p<0.01, and ***p<0.05 for the whole sample.

evaluated by comparing their incidence in patients with NMVO and healthy individuals (Table 3). Various diseases, except for endocrine disorders, were more frequently observed in patients with NMVO (p_t<0.001).

Spearman rank correlation test revealed an intermediate correlation between the incidence of NMVO and other diseases in people of both subethnic groups (ρ=0.47-0.66, p_ρ<0.001). These data suggest that regular and causal factors play a role in the pathogenesis of various diseases. Study of NMVO syndromes showed that diseases of internal organs affect clinical polymorphism of this disorder.

Studies of the role of medical and biological (organism) factors showed that the development of NMVO is determined by the following genetic characteristics: hereditary polygenic predisposition, age, sex, and ethnogenetic features. Premorbid state of the organism and diseases of various organs and systems promote the development and realization of NMVO. The influence of environmental factors requires detailed investigations. Our results show that occupational activity and climatic and geographic factors do not affect the incidence of NMVO [3,7,8].

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