

MIGRATION FROM NORTHERN SIBERIA REGIONS: PSYCHOPHYSIOLOGICAL ADAPTATION OF CHILDREN

MIGRACJA Z REGIONÓW PÓŁNOCNYCH SYBERII: ADAPTACJA PSYCHOFIZJOLOGICZNA DZIECI

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D. Data interpretation
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Summary

Background. This article presents results of research about psychophysiological adaptation of children who migrated from the northern to the southern regions of Siberia. The purpose of this study was to create measures that can be used to promote health among migrants. **Material and methods.** We examined 157 children between the ages of 11-16. Roughly half (n=74) were child migrants, and the remainder (n=83) were children who lived constantly in region of southern Siberia. Psychophysiological adaptation was assessed by methods of Eysenck, Rogov, Belokon and Kuberger. **Results.** Assessment of parameters allowed us to reveal multidirectional results in groups of children. The questionnaire developed by Eysenck showed the predominance of the extroverted type of personality among patients, but emotional instability was more often recorded among child migrants (p=0.0007). Child migrants took significantly longer to complete psychological tests, including tests of attention (p=0.0042) and verbal logical thinking (p<0.001). Vegetative homeostasis was characterized by a higher level of sympathetic tonic initial vegetative tone (p=0.0172), hyper sympathetic tonic variant of vegetative reactivity (p=0.0377), and an altered type of hemodynamic reaction to the clinorhthostatic test (50% of cases). **Conclusions.** The high frequency of emotional instability, slower speed of logical thinking possesses, and sympathetic tonic orientation of vegetative homeostasis parameters are distinctive features of child migrants. Children with deviations in psychophysiological parameters are at high risk of developing psychosomatic pathology. Therefore, preventive measures are necessary to help promote health among child migrants.

Keywords: child, Siberia, migration, adaptation

Streszczenie

Wprowadzenie. W artykule przedstawiono wyniki badań dotyczących adaptacji psychofizjologicznej dzieci migrujących z północnych do południowych regionów Syberii. Celem pracy było wypracowanie metod i środków, które można wykorzystać na rzecz promocji zdrowia wśród migrantów. **Materiał i metody.** Zbadano 157 dzieci w wieku 11-16 lat: dzieci migrantów (n=74) i dzieci, które stale mieszkały w regionie południowej Syberii (n=83). Adaptację psychofizjologiczną oceniano za pomocą metod opracowanych przez Eysencka, Rogova, Belokona i Kubergera. **Wyniki.** Ocena wielu parametrów pozwoliła na ujawnienie wielokierunkowych wyników w grupach dzieci. Dane z kwestionariusza Eysencka wykazały przewagę ekstrawertycznego typu osobowości wśród dzieci obu grup, ale niestabilność emocjonalną częściej odnotowywano wśród dzieci migrantów (p=0,0007). Migranci spędzali znacznie więcej czasu na wykonywaniu testów psychologicznych: ilościowy wskaźnik uwagi (p=0,0042) i logiczne myślenie werbalne (p<0,001). Wegetatywna homeostaza charakteryzowała się wyższym poziomem wegetatywnego tonicznego napięcia początkowego (p=0,0172), hipersympatycznym wariantem tonicznej reaktywności wegetatywnej (p=0,0377), zmienionym typem reakcji hemodynamicznej na test ortostatyczny (50% przypadków). **Wnioski.** Wysoka częstotliwość niestabilności emocjonalnej, niski poziom prędkości myślenia logicznego, sympatyczna toniczna orientacja wegetatywnych parametrów homeostazy są charakterystycznymi cechami psychofizjologicznymi dzieci migrantów. Dzieci z odchyleniami parametrów psychofizjologicznych posiadają wysokie ryzyko rozwoju zaburzeń psychosomatycznych i dlatego konieczne jest wprowadzenie metod i środków profilaktycznych na rzecz promocji zdrowia.

Słowa kluczowe: dziecko, Syberia, migracja, adaptacja

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Introduction

Migration is a universal phenomenon that has existed since the time that people appeared on the Earth. People move from one place to another for different reasons, but the goal or the main reason is to improve their living conditions. Migration is also a social phenomenon that influences the life and health of individuals. Migration includes certain stages, hence, this is a process. In many cases, lack of readiness and/or difficulties with adapting to a new environment can lead to distress among migrants. Moreover, migration has a subsequent negative effect on psycho-physiological aspects of the well-being of the affected population. Hence, here we aim to summarize published studies on migration and its influence on the psycho-physiological aspects of adaptation among migrants [1].

Adaptation is a process of change wherein an organism or species becomes more suitable for the surrounding environment [2]. The term adaptation refers to the adaptation of an individual to new conditions. The biological meaning of adaptation is to establish and maintain a homeostasis that allows an individual to exist in a particular environment with its geographic and ecological characteristics. The popular view on adaptation belongs to the form of a function that evolved through natural selection for a particular function to preserve and maintain homeostasis [2]. The process of adaptation is based on genetic differences between people who have begun to adapt to greater success in a specific environment context. Genetic markers of adaptation to climatic conditions have been identified; in particular, specific genetic variations have been associated with adaptation to cold, particularly in genes that control thermoregulation in the human body [3, 4]. Several studies have shown functional single nucleotide polymorphisms (SNPs) involved in adaptation to environmental conditions [5].

At present, a significant number of northerners move to more favorable territories to live each year, including the southern part of Siberia. This migration undoubtedly affects individuals' level of adaptation and the state of health in general [6, 7]. The living conditions in different latitudes of Siberia vary greatly due to the severity of climatic and geographical parameters, nutrition, and physical activity. These factors create prerequisites for changes in all regulatory systems, including the autonomic nervous system, with the possibility of causing autonomic dysfunction, primary headache, and other diseases of dysregulation [8-11]. In general, the cycle of adaptive adjustment in humans lasts 2-3 years in a new ecological zone with subextremal conditions [12, 13]. Some scientists have described one possible variant for adaptation wherein a person cannot adapt to new life conditions. This state has been described as 'unfinished' adaptation [13].

Unfinished adaptation is associated with dysregulation of both inter- and intra-system interactions that last for months and even years. These processes may include corticosteroid levels, anxiety, and excessive fatigue. Unfinished adaptation is a key factor contributing to risk of neurotic disease and psychosomatic pathology in this context [14]. The main condition for completing the process of adaptation in the body to the effects of an external factor is the return of the homeostatic parameters to the initial level, or stabilization at a new level [13, 14].

Adaptation of a child's body to a new habitat has some differences in comparison to adaptation in adults. In particular, hormonal changes activate receptors across a large number of organs and tissues, which in turn, lead to a generalization of the child's reaction to any new effect [15, 16].

Isaeva, Chernikov, and Bayevsky assert that the circulatory system is a very sensitive indicator of adaptive reactions of the whole organism [17]. Variability in heart rhythm is considered to be the result of the influence of nervous, humoral, and hormonal mechanisms of regulation on the circulatory system. The cardiovascular system is therefore one of the most convenient models, and is widely studied by scientists from the point of view of adaptation processes at the level of the whole organism [18-20]. Organisms become able to perform targeted, specific, well-differentiated reactions during adaptation by the end of the primary school period. After that time, the adaptive response no longer becomes generalized, but rather, is aimed at solving a specific task of adaptation. Adaptation processes temporarily lose their effectiveness and again become less specific during puberty. However, the adolescent's body acquires a level of adaptive capacity by the end of puberty that is similar to that of adults [21].

Any force that requires an adaptive reaction of the organism activates its functional systems to the level of its reserve capabilities. The reserve capacity zone is significantly limited in children, and these reserves may not be sufficient for solving tasks that the organism faces that are required adaptation. Children tend to fall into a state of inadaptation, even under conditions of moderate functional load. Therefore, the problem of the stability of adaptive changes and the balance of the functioning of body systems becomes urgent after the arrival of migrant children from the north to the southern regions of Siberia. However, a comprehensive review of what we currently know about the relationship between migration from the north and the psychophysiological aspects of the adaptation of migrant children has not been undertaken.

Aim of the study

The aim of the study was to assess the psychophysiological characteristics of adaptation among child migrants from the northern to the southern regions of Siberia.

Material and methods

The study was conducted between the years of 2014 and 2017. We examined 157 children (69 boys and 88 girls), ranging in age from 11 to 16 years. Seventy-four of the 157 were children from the northern regions (main group) and 83 were constant residents of the southern regions of Siberia (comparison group). Participants were included in the study after providing written informed consent. Using a physical examination of children, parameters of physical development were consistent with age.

A standard neurological examination was performed, consistent with procedures outlined in [22]. In particular, we utilized a questionnaire developed by Eysenck, which was adapted for children. Brain functioning was assessed via psychodiagnostic tests for children, using the (1) exclusion of concepts test, which evaluates verbal-logical thinking, and (2) the reproduction of figures task, which examines attention. Consistent with Rogov [23], we recorded the number of correct answers and the time in seconds taken to complete the tasks. Next, we performed cardiointervalography via a clinooorthostatic test developed by Belokon & Kuberger [24]. This test provides prognostic information about the functional state and features of adaptive responses of the whole organism. We focused on the following cardiointervalography parameters: mode, amplitude mode, variation range, stress index of regulatory systems at rest, initial vegetative tone, vegetative reactivity, and vegetative maintenance of activity. Vegetative reactivity was determined by the dynamics of stress index of regulatory systems in response to the transition from the horizontal position to the vertical position, as well as, evaluating it as normal, hypersympathicotonic, and asympathetic. Vegetative maintenance of activity was assessed by the dynamics of arterial pressure and heart rate within 10 minutes after a clinooorthostatic test. Children who showed an adequate response to hemodynamics during the clinooorthostatic test were assigned the normal variant of vegetative reactivity.

Vegetative reactivity was determined by the dynamics of stress index of regulatory systems in response to the transition from the horizontal position to the vertical position, evaluating it as normal, hypersympathicotonic and asympathetic. Vegetative maintenance of activity was assessed by the dynamics of arterial pressure and heart rate within 10 minutes after a clinooorthostatic test with the release of excess (hypersympathicotonic) and inadequate (asympathicotonic). Children which gave an adequate response to hemodynamics at clinooorthostatic test belonged to the normal variant.

Data analysis was carried out using nonparametric tests [25] in the statistical program STATISTICA 6.0 (StatSoft Inc.USA). Mann-Whitney U tests were applied to quantitative data (in points), which are presented in the form of Me – median, 25–75%. Qualitative variables were tested using a chi-square test, with the Yeats amendment. Qualitative data are presented in the form of absolute and relative percentage, with a 95% confidence interval. Results were considered statistically significant at a significance value of $p < 0.05$. This research was examined and approved by the Research Ethics Committee of the Science-Research Institute of Medical Problems of the North Russian Academy of Sciences (Siberian Branch; Krasnoyarsk, Russia).

Results

The results of a comparative study of psychoemotional aspects in children by G.Yu. Eysenck

Results of the Eysenck scale are shown in Table 1. Results of the Eysenck introversion/extraversion personality scale revealed a predominance of the extroverted type among all examined children (over 60%, $p_{1,2} < 0.001$; $p_{3,4} = 0.0004$, Table 1). Overall, level of extraversion was in the moderate range (i.e., 14-15 points). Extroverted children are characterized by the following personality traits: cheerfulness, optimism, activity, contact, and individuality. Introverted personality type was found in 1/3 of all tested children, and level of introversion was in the moderate range (i.e., 9-10 points). Introverted children have the following personality features: restraint, and tendency for introspection and inner experiences. Level of emotional stress (as measured by the neuroticism-emotional stability scale) was evaluated in accord with Eysenck scale [26].

Among child migrants, emotional instability exceeded the upper limits and corresponded with levels of 'very high' emotional instability (19-20 points). In the comparison group, in contrast, emotional instability remained in the 'high' range (16-17 points). Among migrants, increased personal anxiety corresponded with a feeling

of uncertainty, mood swings, and a tendency to delay emotions. Only 1/3 of child migrants met criteria for emotional stability, whereas 65% of children who lived constantly in southern Siberia met criteria for emotional stability. Level of neuroticism was in the 'average' of emotional stability (i.e., 11-14 points). Taken together, the psychoemotional state of child migrants from northern regions was characterized by emotional instability that reached a neurotic level. There were no gender differences.

Table 1. Indicators of the intra – extraversion personality type and level of emotional stress (neuroticism – emotional stability) as measured using the Eysenck questionnaire among child migrants from northern Siberia during an adaption period, and comparison children

Indicators	Extraversion-introversion				Neuroticism-emotional stability			
	Child migrants (n=74)		Comparison children (n=83)		Child migrants (n=74)		Comparison children (n=83)	
	Extroverts	Introverts	Extroverts	Introverts	Emotionally stable	Emotionally unstable	Emotionally stable	Emotionally unstable
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
abs. number	51	23	53	30	28	46	54	29
%	68.9	31.1	63.8	36.2	37.8	62.2	65.1	34.9
%, CI	57.64-78.37	21.73-42.41	53.08-73.37	26.62-46.91	27.63-49.26	50.73-72.36	54.30-74.48	25.55-45.69
chi ²	21.19 12.75				8.76 15.06 11.55			
p (chi ²)	p _{1,2} < 0.001; p _{3,4} =0.0004				p _{5,6} =0.0035; P _{7,8} =0.0031; P _{6,8} =0.0007			

CI – confidence interval (95%)

The results of a comparative study of psychodiagnostic tests in children by E.N. Rogov

Indicators of higher cerebral functioning were estimated via test scores of attention volume and verbal-logical thinking by Rogov [23]. Psychological examination revealed a high level of task performance for all children. Only children who showed interested in the study and attentively to the assignments were included. No more than two mistakes were allowed while performing tasks. Mental activity among child migrants was characterized by a slower rate of completing certain tasks in comparison with the control group. Child migrants showed a significant increase in the time index for the amount of attention (child migrants: Me=18 s, 25 %₀ -75 %₀ = 15-20 s; comparison children: Me=15 s, 25 %₀ -75 %₀ =15-19 s, p_{chi2}=0.0042) and verbal-logical thinking (child migrants: Me=50 s, 25 %₀ -75 %₀ = 40-55 s; comparison children: Me=42 s, 25 %₀ -75 %₀ =35-50 s, p_{chi2}<0.001).

Formation of adaptive reactions to a new habitat in children was due to vegetative regulation of somatic functions, and in particular, cardiac activity [24]. Collection of indicators from child migrants made it possible to form groups of children depending on their initial vegetative tone (Table 2). The largest group was children with eutonia, which reflects the optimal ratio of the sympathetic and parasympathetic nervous systems (i.e., normal stress index; 30-90 conventional units). This is typical for a satisfactory adaptation of the organism to a new habitat. Comparative analysis revealed a tendency for lower eutonia (p_{2,5}=0.0551) and a significant increase in sympathicotonia (p_{3,6}=0.0172) in the group of child migrants compared to the control group. These results correspond with tension within regulatory mechanisms, and incomplete adaptation [17, 21].

Table 2. Distribution of children according to the indices of initial vegetative tone

Indicators	Child migrants, n= 74			Comparison children, n= 83		
	Vagotonia	Eutonia	Sympaticotonia	Vagotonia	Eutonia	Sympaticotonia
	[1]	[2]	[3]	[4]	[5]	[6]
abs. number	17	37	20	20	53	10
%	22.9	50.0	27.1	24.1	63.8	12.1
CI, %	14.88-33.79	38.86-61.13	18.24-38.13	16.18-34.34	53.08-73.37	6.72-20.80
chi ²	3.07 5.68					
p (chi ²)	p _{2,5} =0.0551; p _{3,6} =0.0172					

CI – confidence interval (95%)

The results of a comparative study of physiological parameters of adaptation on cardiac rhythm by the method of cardiointervalography with a clinooortostatic probe in children by M. Belokon, N.A. Kuberger

Rhythm of the heart is a sensitive indicator of adaptive responses of the organism to the habitat [24]. The analyzed indicators of cardiointervalography in child migrants and children of the comparison group are given in Table 3.

Table 3. Indicators of cardiointervalography among child migrants and comparison children by M. Belokon, N.A. Kuberger

Indicators*		Child migrants (n=74)	Comparison children (n=83)	Statistical significance by Mann-Whitney (p)	
Mo, s	Me	0.72	0.72	p=0.0073	
	25%-75%	0.64-0.74	0.68-0.78		
DX, s	Me	0.25	0.28		
	25%-75%	0.20-0.30	0.24-0.34		
AMo, %	Me	26.00	22.00		p<0.001
	25%-75%	23.00-34.00	17.50-24.00		
IS1, conv. units	Me	65.00	50.00	p<0.001	
	25%-75%	47.00-92.00	35.50-64.00		

* Mo – mode, DX – variation range, AMo – amplitude mode, IS1 – stress index of regulatory systems at rest

Child migrants showed an increase in sympathetic effects on the heart rhythm, as measured amplitude mode ($p < 0.001$) on the background of a decrease in the influence of the parasympathetic link on the variation range ($p = 0.0073$). Dysregulation of the autonomic nervous system was further reflected in an increase in the stress index ($p < 0.001$) in migrants relative to comparison children. These results are consistent with previous studies [18, 19].

Evaluation of initial vegetative tone in children may be more informative than assessing indices of vegetative reactivity. Vegetative reactivity characterizes the direction and degree of changes in the functioning of the autonomic nervous system at the moment of the organism's transition from one state to another. Variants of vegetative reactivity in child migrants and comparison children are depicted in Table 4.

Table 4. Variants of vegetative reactivity among child migrants and comparison children

Indicators	Child migrants (n=74)			Comparison children (n=83)		
	Normal	Asympaticotonic	Gipersympaticotonic	Normal	Asympaticotonic	Gipersympaticotonic
	[1]	[2]	[3]	[4]	[5]	[6]
abs. number	36	14	24	43	25	15
%	48.6	19.0	32.4	51.8	30.1	18.1
CI, %	37.58-59.84	11.64-29.33	22.86-43.77	41.19-62.25	21.31-40.40	11.29-27.73
chi ²	4.32					
p (chi ²)	p _{3,6} =0.0377					

CI – confidence interval (95%)

Heterogeneity of adaptive reactions to the load was revealed in all examined children with different initial vegetative tone. The normal (i.e., sympathicotonic) variant of reactivity was determined in half (50%) of all examined children. Migrant children were more likely to show hypersympaticotonic orientation of the cardiovascular system than comparison children ($p_{3,6} = 0.0377$), which indicates the tension of the adaptive-compensatory mechanisms of cardiac regulation [21].

Vegetative maintenance of hemodynamics activity on the clinooortostatic test was assessed. A normal response was found in more than half of all children surveyed (among child migrants: 51.4% [n=38], among comparison: 60.2% [n=50]).

The excess reaction was primarily hypersympaticotonic (child migrants: 6.7% (n=5); comparison children: 7.2% (n=6)). An insufficient reaction was indicated by an initially insufficient inclusion of the sympathetic link in orthostasis, and was represented by various variants. In particular, the asympaticotonic variant was found in 14.5% of child migrants (n=12) and 9.4% of children (n=7). Other variants were found in single cases only.

Discussion

Probably, the characteristic of mental activity is due to the emotional state of child, in particular, the higher frequency of emotional instability that affects the pace of thought processes and is consistent with the literature data [26, 27].

Given the continuous dynamic demographic changes due to intensive migration, it is necessary to understand more fully how migrants adapt to their new habitat. However, at least for domestic migration (as opposed to international), it appears that more people migrate to locations with warmer climates than cooler ones. For example, migration in the United States is generally towards the "Sun Belt" and not the "Frost Belt" [28].

A review of relevant local and international literature was conducted. The literature reports many problems of human adaptation in new habitat, especially among children from northern regions [8, 17]. The gaps in psychophysiological adaptation identified in the literature are of particular importance to adaptation in children.

Various adaptation variants were found. A balanced state of homeostatic systems at the level of the whole organism was found in 50% of child migrants and the majority of child residents. Emotional stability is characterized by an optimal state of higher cerebral functions, higher frequency of normal vegetative reactivity, and a normal type of hemodynamic response. These patterns correspond with a variant of satisfactory adaptation according to Bayevsky [17].

Child migrants showed a predominance of emotional instability and at a very high level (19-20 points) and took longer to complete the psychological tests (i.e., attention, verbal thinking). These results may be driven by the emotional state of child migrants; in particular, by a higher frequency of emotional instability which affects the pace of thought processes [25, 27]. Similar results of psychoticism were noticed by other authors [29].

Formation of adaptive reactions depends on the state of central and peripheral links of the higher nervous system, which determines the nature of emotional responses and the behavior of the individual. Responses and behavior, in turn, provide a level of variability in vegetative-visceral functions as a result of the constant interaction between the organism and the new habitat [1, 24].

Vegetative homeostasis of child migrants was characterized by a higher level of sympathetic initial vegetative tone, a hypersympathicotonic variant of vegetative reactivity, and an altered hemodynamic response during a clinooortostatic test. Formation of adaptive reactions in children is due to the activity of the autonomic nervous system in new habitat conditions. Maintaining a certain level of vegetative tone is one of the critical factors that determines the integral state of somatic functions. Parameters of vegetative homeostasis reflect the interaction of the control elements of the circulatory system, which makes it possible to assess the state and degree of tension of the regulatory mechanisms of the whole organism [18, 19, 24, 30].

Data in the present study corresponded with unfinished adaptation that occurred within 3 years of moving to the new territory. Thus here, unfinished adaptation was a factor in the development of psychosomatic pathology in children (i.e., autonomic dysfunction syndrome).

This report shows how children undergo psychophysiological adaptation when migrating from northern to southern Siberia. In all cases, children receive priority attention: the Convention on the Rights of the Child provides a legal framework. When planning adaptation, doctors give advice on the time of movement and the prevention of diseases, which is an accepted international practice [31, 32]. However, the Commission on Climate Change and Development insists that "approaches to adaptation should recognize the highly differentiated nature of adaptive capacity across households, ages, geographic locations, gender, and ethnicity and not prescribe 'one-size-fits all' solutions" [32].

This study does not cover all aspects of the problem regarding the adaptation of child migrants from northern Siberia. Nevertheless, increasing knowledge of the psychophysiological factors of adaptation will help to find new solutions for improving adaptation and preventing diseases of dysregulation.

Conclusions

The present study confirmed the existence of different variants of adaptive possibilities in child migrants. We found child migrants showed a higher incidence of emotional instability, lower rate of thought processes, and demonstrated a sympathicotonic orientation of the vegetative homeostasis parameters. Children with deviations of psychophysiological parameters are at high risk of developing psychosomatic pathology. Thus, it is necessary to introduce preventive measures for health promotion among at-risk children.

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