Medicobiologic risk factors in early child development as predictors of psychological health in first grade students living in the Arctic region

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Abstract. The article presents data on the interrelationships between psychological health characteristics and medicobiologic risk factors of disontogenesis among first-grade students. The study covered 193 first-graders (80 girls and 113 boys) living in the European North of Russia. The sixteen methods applied have allowed to describe psychological health characteristics at the physiological, psycho-physiological, psychological and socio-psychological levels. It has been revealed that all psychological health indicators of a 7- to 8-year-old child are closely related to the medical and biological risk factors identified in preschool period of development. It is noted that the studied risk factors affecting a child aged 3 to 7 have closer links with characteristics of psychological health. The data obtained suggests that the developmental characteristics of a child aged 3 to 7 affect personal health to a greater extent in comparison with other previous age periods of ontogenesis, determining first-graders’ success adapting to a new social environment and systematic learning activities at school. The study confirms the importance of studying the long-term consequences of the adverse influence the medicobiologic factors cause in pre-school period of ontogenesis on schoolchildren’s psychological health. The authors emphasize that the comprehensive analysis of pre-school childhood development is what provides not only the picture of the current dysontogenesis risk factors, but also the direction for correctional work, based on individual characteristics of psychological health.

1. Introduction

In extreme climatic, geographic, anthropotechnological, and socio-economic conditions of the Arctic zone, there has been a decrease in the level of children’s health [1]; deviations in mental and psychological health of children and adolescents are often observed [2]. The researchers argue that the reserve capacity of the homeostatic mechanisms in children living in Arkhangelsk Regiona [3] is reduced as early as in the period of embryo- and phylogensis [4]. It is shown that the influence of “damaging” medicobiologic factors, especially in the early stages of ontogenesis, are crucial to the development of children’s higher mental functions [5].

The problems of public health and maldevelopment prevention have become the focus among research teams in the recent decade, the psychological, pedagogical and medical publications actively discussing the facts indicative of serious problems of mental and psychological health in younger generations. In the domain of psychological health studies, great interest is aroused by the studies ingrelate to the influence of risk factors on the success of individual development [6; 7; 8]. Currently, the research into the relationship between early dysontogenesis risk factors and children’s psychological health is considered to be socially significant, especially given the present-day, social pressure on human body and psyche.
According to V.E. Loginova, there exist the following risk factors: medicobiologic (innate characteristics, health disorders, abnormalities in mental and physical development, etc.); socio-economic (minor parents, large and single-parent families, suicidal behavior, thievery, bullying, drug and alcohol use, etc.); psychological (emotional instability, non-acceptance of oneself, poor progress/performance, poor social adaptation, communication difficulties and difficult interaction with adults and peers, etc.); and pedagogical (prevalence of negative assessments, discrepancy between the content of curricula, learning setting and children’s neurophysiological characteristics, etc.) [9].

At the same time, the influence of biomedical risk factors of diosontogenesis on psychological health remains underexplored, even though these factors have been recognized to cause the most pronounced effect on children’s mental development and health [10; 11]. No comprehensive study has so far been undertaken into the relationship between medicobiologic risk factors and children’s psychological health at critical developmental period, when the transition occurs from preschool childhood to school life, representing a turning point in child’s life and personality formation. Therefore, the purpose of this research was to study the interrelationship between medicobiologic risk factors of early dysontogenesis and the indicators of psychological health in first-grade students living in the Arctic region.

2. Methods
A total of 193 first-graders (80 girls and 113 boys) – all residents of Arkhangelsk – were examined. The survey was carried out with consent from their parents, teachers and children themselves in the first half of the day, following all the principles of the 2013 Helsinki Declaration. According to the document called “History of childhood development. Form 112/u” [12], which is due to be provided when children enroll in schools, the examined children were practically healthy, did not have any chronic or acute diseases of central nervous system, nor severe neurological or mental disorders.

The psychodiagnostic of the levels and characteristics of psychological health was carried out by standardized, commonly used, verified methods – “Houses” by O.A. Orehova; “House – tree – man” with the use of symptom-complex according to R.F. Belyauskaitė; “Faces” (N.V. Lukyanchenko, T.L. Yadryshnikova); “Diagnostics of psychoneurological symptoms in school students”; methods for assessing maturity of visual perception in 5- to 7.5-year-old children (M.M. Bezrukikh, L.V. Morozova); methods for determining levels of speech development and verbal thinking (L.A. Yasyukova); methods for assessing learning aptitude (G.V. Repkina, E.V. Zaika); “Diagnistics of psychoneurological symptoms in school students”; methods for assessing learning aptitude (G.V. Repkina, E.V. Zaika); “What is good and what is bad”; “How to act?”; questionnaire “Well-being, activity, mood: subjective well-being of primary school children” by T.V. Arkhireyeva; questionnaire for teachers “Determining children’s socio-psychological adaptation to school” (E.M. Alexandrovskaya, N.G. Lukanova); Toulouse-Pieron test; test “Recognising figures” (N.A. Bernstein), “Learning 10 words” (A.R. Louriya), “A conversation with first-grade students to identify whether their ideas of moral and volitional qualities correspond to age”. This set of methods allowed to describe the characteristics of psychological health at psycho-physiological, psychological, social and psychological levels.

The medicobiologic risk factors of early development were diagnosed by analyzing students’ medical records and through questionnaires filled out by parents and teachers “The Characteristics of Early Child Development” [13]. To analyze risk factors of dysontogenesis, certain periods of development were considered: under 1 year (questions block 1); from 1 to 3 years (questions block 2), from 3 to 7 years (questions block 3). A total of 49 medicobiologic risk factors of dysontogenesis were analyzed. Each risk factor was given a score. The higher the score, the more likely the negative impact of the factor on the child.

For data processing, statistical package for analysis SPSS Statistics 22.00 for Windows was used (License Agreement No. Z125-3301-14, Northern Arctic Federal University named after M.V. Lomonosov). Descriptive statistics were used to elicit the most common risk factors of dysontogenesis. Normalcy of distribution was verified by Kolmogorov-Smirnov test. Due to the abnormal distribution of characters, Spearman’s rank correlation analysis was performed to identify relationships between the indicators under study.
3. Results and discussion

Given that the factors causing negative impact on childhood development are numerous, in our study we focused on the most significant ones, such as parents’ age, heredity, pregnancy pathology, diseases suffered by mothers and their children, among others. Among the medicobiologic risk factors under analysis, most frequently encountered are mothers aged 26+ (49.7%); smoking fathers (37.4%) and mothers (14.7%); drug abuse during pregnancy (22.5%); Cesarean section (18.9%); toxicosis in the first half of pregnancy (17.6%); mothers’ poor health during pregnancy (14%); and artificial feeding of newly-born children (14%).

Researchers argue that mother’s age over 26 at childbirth is a fairly common risk factor and is observed in 20% [14] to 30.5% of cases [15]. Women aged 26+ are running higher risks of obstetrical or perinatal pathologies leading to fetal hypoxia, operative delivery, intrauterine growth retardation, abnormal course of early neonatal period of in the form of morphofunctional immaturity, and infectious complications [16; 17].

The number of smoking women is on the increase practically everywhere in the world. Smoking is continued by 55% of pregnant women in the U.S.A., 43% in the UK, 45% in Poland, and 23% in Russia [18]. Moreover, tobacco smoking among pregnant women does not tend to decrease. 14.7% of our respondents claimed they smoked during pregnancy. Inhaled passively or actively, nicotine has a multifacetedly negative effect on pregnant women, affecting fetus, disrupting the production of progesterone and prolactin in pregnant women, which are crucial to normal development of the fetus, and causing vessels in uterus, placenta and fetus to narrow. Reduced uterine blood flow causes fetal hypoxia and abnormality of its trophism. Intensified, these processes lead to viral and bacterial infections, asphyxia, congenital malformations, functional disorders of CNS [19], delayed mental and physical development in newborns [20] and delayed development of behavioral patterns, affecting children’s learning capacity in later periods of development [21].

Considering the negative impact on childhood health of the medicobiologic risk factors identified, a lot of known facts can be cited, but it should be emphasized that in the environmentally challenging conditions of the Subarctic region a more marked, combined effect of a variety of factors occurs. It has a traumatic effect on all levels of health, including psychological. The statistically significant relations between medicobiologic factors, specific of different age periods, and psychological health characteristics are presented in Table 1.
Table 1: Correlated medicobiologic risk factors of dysontogenesis and psychological health characteristics in the first-grade students examined.

| Psychological health levels | Psychological health characteristics | Statistical value | Medicobiologic risk factors up to 1 year (block 1) | from 1 to 3 years (block 2) | from 3 to 7 years (block 3) | up to 7 years (all blocks) |
|-----------------------------|------------------------------------|-------------------|---------------------------------------------------|-----------------------------|-----------------------------|----------------------------|
| Physiological               | subjective feeling of internal physical comfort | r                 | -0.431                                            | 0.000                        | 0.000                        | 0.000                      |
| Psychophysiological         | mental activity factors neurophysiologically structured | p                 | 0.182                                             | 0.079                        | 0.037                        | 0.182                      |
| Emotionl health             | optimism                           | r                 | -0.182                                            |                             |                             |                             |
|                             |                                    | p                 | 0.036                                             |                             |                             |                             |
| Psychological               | emotional adaptation               | r                 | -0.177                                            | 0.019                        | 0.019                        | 0.019                      |
|                             | emotional well-being at school      | r                 | -0.133                                            | 0.079                        | 0.078                        | 0.079                      |
| Cognitive                   | psychomotor performance            | r                 | -0.213                                            |                             |                             |                             |
|                             | attention concentration and lack of attention deficit | r                 | -0.146                                            | 0.099                        | 0.005                        | 0.005                      |
|                             | short-term aural memory and lack of its deficit | p                 | 0.045                                             | 0.056                        | 0.031                        | 0.013                      |
|                             | visual space perception and lack of its deficit | r                 | -0.207                                            |                             |                             |                             |
|                             | speech development and lack of its deficit | p                 | 0.050                                             |                             |                             |                             |
|                             | verbal and logical reasoning        | r                 | -0.224                                            |                             |                             |                             |
|                             |                                    | p                 | 0.014                                             |                             |                             |                             |
| Behavior regulation         | self-regulation and self-control    | r                 | 0.189                                             | 0.019                        | 0.019                        | 0.019                      |
|                             | goal-setting and attainment using adequate means | p                 | -0.390                                            |                             |                             |                             |
|                             | ability to adequately plan learning activities | r                 | -0.503                                            |                             |                             |                             |
|                             | life control                        | r                 | -0.193                                            |                             |                             |                             |
|                             | activity control                    | r                 | -0.233                                            |                             |                             |                             |
|                             | socio-psychological adaptation      | p                 | 0.005                                             | 0.048                        | 0.000000                    |                             |
| Adaptable                   |                                      | p                 | -0.555                                            | -0.332                       |                             |                             |
| Healthy communication       | positive attitude towards people    | r                 | -0.207                                            |                             |                             |                             |
|                             | lack of hostility                   | p                 | 0.163                                             | 0.242                        | 0.003                        |                             |
|                             | credibility                         | p                 | 0.054                                             | 0.003                        |                             |                             |
|                             | lack of communication difficulties  | r                 | 0.181                                             | 0.026                        |                             |                             |
|                             | lack of traumatic experiences in communication to date | p                 | 0.203                                             | 0.012                        | 0.019                        |                             |
|                             | adequacy and healthy moral behavior | r                 | -0.206                                            | -0.203                       | -0.233                       | -0.233                      |
|                             | perception of humanist values (the value of human life, nature) as important | p                 | 0.018                                             | 0.019                        | 0.012                        | 0.019                      |
|                             | orientation towards virtue, justice, moral commitment, conscientious behavior | p                 | 0.270                                             | 0.041                        | 0.001                        | 0.001                      |
According to the results of Spearman rank correlation, the medicobiologic risk factors in childhood development period up to a year can have a “long-term” effect on cognitive and spiritual health. The relationships obtained show the significance being job-protected while pregnant, which is reflected primarily in the functional maturity of the brain [5; 22; 23]. Delayed, according to the stage of development, formation of the functional systems of central nervous system can lead to cognitive deficit, manifested in abnormality of cognitive, mental and spiritual health [6; 10; 11].

Experts note that crucial to the healthy childhood development is prenatal and the period up to one year. So, a particular interrelation exists between the periods when medicobiologic factors have their strongest influence in ontogenesis and the nature of subsequent neuro-psychological deviations. It has been found that the disorders occurring in the early stages ofontogenesis more often cause lesions in subcortical structures of the brain, whereas factors in pre- and postnatal periods mainly influence the formation of higher cortical functions, determining the cognitive health of the child. This pattern can be explained by the principle of heterochronic development of different parts of the brain [24]. The variety of etiological factors can, in the future, lead to increased excitability, aggressiveness, attention distraction, rapid exhaustion, changes in general and fine motor skills, speech dysfunctions, etc. [25].

The data obtained by neurophysiologists show that in growing individuals the brain, due to its flexibility, forms individual behavior patterns based on the social and cultural settings. Therefore, the first year of life is very important. The “child-adult” connections that are formed during the first year of life harmonize the egoistic and altruistic beginnings in children provided that they are loved and love and care for others. Excessive care and caress or, oppositely, neglect block in children the need for emotional contact, stimulating egocentrism and inferiority complex. The factors blocking the development of creativity in a growing person include disturbed emotional ties in family; adverse status of the child in interpersonal relationships; low importance for the child of the surrounding communities, especially if these lack moral orientations; and neglect of the child’s need in social contact [26].

The number of correlations between the medicobiologic risk factors and the psychological health characteristics in first-grade students increases as the analysis of the developmental period from 1 year to 3 years continues. Significant relationships with psycho-physiological, emotional, cognitive, spiritual, socio-psychological levels of psychological health have been revealed. It is known that during this period of ontogenesis the formation of higher mental functions and elements of self-consciousness is intense [27]. According to many authors, the diseases suffered by children during this period – the most important medicobiologic risk factor – have an adverse effect not only on the immune system and physical health, but also on the formation of emotional and behavioral spheres [28], causing tendency for higher stress levels when exposed to new environments, limited social experience, difficulties in interpersonal communication, among others, ultimately leading to socio-psychological maladjustment in society and disturbed moral behavior [29].

An even closer relationship between the dysontogenesis risk factors and all levels of psychological health has been identified when analyzing the developmental characteristics of the age of 3 to 7 years. This stage of ontogenesis is characterized by active physical and mental development. Preschool age is the period when personality starts to emerge in children, when they seek self-actualization by initiating things and setting life goals, when emotional attitude to one’s self starts to form itself, and sense of pride in one’s own achievements and positive self-esteem form, which together form the basis of preschooler’s psychological health [30].

The age of 3 to 7 years is when children receive the experience of social interaction and prepare for school, a new social setting for them [28]. The damaging effect of medicobiologic factors of dysontogenesis is exacerbated by the combined influence of adverse environmental and socio-economic factors of the Subarctic region. Researchers point out that exposure to temperature differences and asymmetric photoperiodism do contribute to hypokinesia, reducing the development of visuospatial perception. Spending 90% of free time confined spaces, especially in winter season, leads to a decrease in the production of vitamin D, which is responsible for balanced physical and mental development in children [4].
4. Conclusion
The study has confirmed the importance of studying the long-term effects of the adverse influence of medicobiologic factors on the psychological health of first-grade student. As the number of medicobiologic risk factors of dysontogenesis increases, the sphere their influence of psychological health levels increases proportionally. It has been found that all the psychological health indicators in children aged 7 to 8 years are closely related to the medicobiologic risk factors identified in preschool period of development. It is noted that the studied risk factors affecting children aged 3 to 7 years, have a closer relationship with psychological health characteristics. According to the data obtained, the age 3 to 7 years in more crucial, compared to all previous periods of ontogenesis, in terms of health and first-graders’ success adapting to a new social environment and teaching-and-learning system. It should be emphasized that the comprehensive analysis of preschool childhood development is what provides not only the picture of the current dysontogenesis risk factors, but also the direction for correctional work, based on individual characteristics of psychological health.

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References
[1] Markova S V, Amosova A M and Zakharova N M 2016 The health status of children living in the Arctic zone Vestn. N-E Fed. Un. n. a. M K Ammosov 3(04) pp 46–48
[2] Pahalyan V E 2006 Development and Psychological Health: Preschool and School Age (Moscow: Piter) p 294
[3] The Decree of the President of the Russian Federation of May 2, 2014 no. 296 On the Land Territories of the Arctic Zone of the Russian Federation (Electronic Materials)
[4] Koposova T S, Zvyagina N V, Lukina N V, Morozova L V, Malyshev D A, Nasonova N V, Kazakova E V and Yemelyanova T V 2010 Morphofunctional and Physiological Status of Children and Adolescents of the Circumpolar Region (Arkhangelsk: Solti) p 214
[5] Vasilieva E V 2005 Psychophysiological Status of Children 6-8 Years Old with Risk Factors for Early Dysontogenesis Diss. Cand. Biol. Sci. (Arkhangelsk) p 166
[6] Sergienko E A and Vilenkaya G A 2004 Dynamics of changes in early mental development: psychogenetic and ontogenetic aspects RHSF Bulletin 4(37) p 105–18
[7] Sokolova O A and Sergienko E A 2007 Dynamics of personal characteristics of women during pregnancy as a factor of mental health of mother and child Psy. J. 28(6) pp 69–82
[8] Sergienko E A and Vetrova I I 2012 The Ratio of Behavioral Control, Coping and Psychological Protection ed A L Zhuravleva and E A Sergienko (Moscow: Publ. Inst. Psy. RAS) section 1 chapter 4 pp 332–41
[9] Surikova M D 2013 Children at risk and their psychological characteristics Young Scientist 4(51) pp 607-09
[10] Borozdina L V and Pukinska O V 2011 Characteristics of intelligence in connection with the “risk triad” Ques. Psy. 4 pp 3–12
[11] Nikolaev E I and Fedorchuk V I 2013 Internal picture of the child’s health as a prognostic factor of general health Proc. Int. Conf. Dedicated to the 80th Anniv. of A V Brushlinsky “Man, Subject, Personality in Modern Psychology” ed A L Zhuravleva and E A Sergienko vol 2 (Moscow: Publ. Inst. Psy. RAS) pp 455–57
[12] Samarina V N and Vorontsov I M 2016 The History of the Child (Saint-Petersburg: Publ. SpetsLit SPb p 223
[13] Bezrukikh M M, Sonkin V D and Farber D A 2003 Age-specific Physiology (Moscow: Publ. Center Academy) p 416
[14] Sitnikova L N and Lavlinskaya L I 2014 Organization of medical care for pregnant high-risk groups Bulletin of New Med. Tech. 1
[15] Bezmaternykh T V 1986 Influence of perinatal risk factors on the health status of newborns Proc. Perinatal Path. and Child Health (Perm: Publ. PSMU) p 10–12
[16] Safronova L A 2003 Actual Problems of Perinatal Pathology (Moscow: ANMI) p 46
[17] Miletic T Aberle N and Mikulandra F 2002 Perinatal outcome of pregnancies in women aged 40 and over Coll Antropol 26 pp 251–58
[18] Radzinsky V E, Semyatov S D and Totchiev GF 2009 Tobacco smoking and pregnancy Bulletin of RUDN 7 pp 334–40
[19] Gissler M, Meriläinen J and Vuori E 2003 Register based monitoring shows decreasing socioeconomic differences in Finnish perinatal health J. Epidemiology and community health 57(6) pp 433–39
[20] Gissler M, Pakkanen M and Olausson P O 2003 Fertility and perinatal health among Finnish immigrants in Sweden Soc. Sci. and Med. 57(8) pp 1443–54
[21] Hall R T, Santos S R and Cofield F 2003 Perinatal outcomes in a school-based program for pregnant teen-agers Miss. Med. 100(2) pp 148–52
[22] Vasilyeva O S 1999 Psychological health of the personality Soc. Psy. Pers. ed. V A Labunskaya (Moscow: Gardariki) pp 359–72
[23] Chernov D N 2016 The role of biomedical factors in the language development in schoolchildren: a review of contemporary research Mod. Res. on Soc. Problems (Electronic Scientific Journal) 11(67) pp 228–47
[24] Syrotyuk A L 2003 Neuropsychological and Psycho-physiological Support of Education (Moscow: TC Sphere) p 288
[25] Kachanova L A, Ryabchikova T V and Laskaryova L N 2001 Adaptation characteristics of primary school age children, born with intrauterine growth retardation, as a manifestation of a traumatic situation Perinatal Psy. and Med. Psychosomatic Disorders in Obstetrics, Gyn., Ped. and Ther. (Ivanovo) part 1 pp 286-90
[26] Apticiev L R, Aptikeev A Kh and Bursakova M S 2014 The family as a factor of the child’s personal development Bulletin Orenburg State Un. 7(168) pp 185-90
[27] Nikiforova G S 2010 Psychology of Preschooler Health (Saint-Petersburg: Speech) p 413
[28] Bukreeva E A, Dolgikh S P 2016 How to maintain good preschoolers’ psychological health Young Scientist 18 pp 433-36
[29] Mash E and Wolf D 2002 Abnormal Child Psychology (Wadsworth: Thomson learning) p 146
[30] Nikiforov G S 2014 Human energy potential Bulletin of St. Petersburg State Un. 3(16) pp 13-20