

Infectious Diseases as A Risk Factor for Impairment of Mental Functions and Deterioration of Academic Performance at School

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ABSTRACT

The purpose of the study was dynamic assessment of academic performance and higher mental functions of schoolchildren in elementary school and during transition to subject-based education.

The test-based analysis of higher mental functions in schoolchildren with recurrent respiratory infections (RRI) at the stage of primary education has shown an increase in the ratio of schoolchildren with low values according to the offered tests characterising activity and independence in cognitive and social activities (the WAM method), motivation and academic performance (the “Landolt’s correction test”), logical thinking (a test for the development of logical and cognitive processes by Leontiev A.N.) and indicators of attention and performance of the child (the Toulouse-Pieron test).

The characteristic behavioural features of children with RRI during the transition to subject-based education are a decrease in communication skills (the “Man in the rain” drawing test) and a high level of anxiety in 70% of the schoolchildren (Spielberger-Khanin test).

Keywords: Schoolchildren, Higher Mental Functions, Academic Performance

Introduction

The high incidence of acute respiratory infectious diseases in children in Russia demonstrates the need to obtain new data on the problem. According to A.A. Baranov and other researchers diseases acute respiratory occupy the first place in the structure of morbidity in preschool children, with 49.5% falling on children with long-term and frequent illnesses (Albitsky and Baranov, 2003; Baranov *et al.*, 2020; Anoshkina, 2018).

Recurrent diseases accompanied by stress reactions in the child’s organism may lead to disturbances and undesirable changes in the systems providing for adequate metabolic, immune and

psychological response of the body (Morozov, 2019; Badina, 2012). It is known that recurrent infections may affect the educational process of a child worsening the learning outcomes and reducing academic performance (Shebotinova, 2016; Kovalevsky and Gruzdeva, 2010). Frequently ill children often develop features of psychological behaviour that complicate communication with peers, contribute to infantilism, anxiety, and reduced performance (Romantsov *et al.*, 2016; Pao and Bosk, 2012; Khalid-Khan *et al.*, 2009).

The data on evaluation of these impairments (especially at different stages of school education) are few and contradictory.

The listed peculiarities define the importance and necessity of continuing these studies.

Purpose of the Study

Analysis of academic performance results and assessment of higher mental functions at the most significant stages of school education (completion of the first year of study and transition to subject-based education).

Materials and Methods

Presented results of a comprehensive medical, psychological and pedagogical examination of 437 schoolchildren at various stages of education (before entering school, at the end of the first year of study and during the transition to subject education). Children were followed up for 5 years. Based on the results of a dynamic health assessment, a group of 60 schoolchildren was formed, of which 20 children were diagnosed with recurrent respiratory infections (RRI) and 40 control children (rarely ill).

The work uses data from medical and pedagogical documentation, anamnesis information and test results at the following stages of schooling was carried out: before entering school, at the end of the first year of study and during the transition to subject-based education.

The progress of each child was assessed at the end of the academic year, taking into account a set of disciplines included in the relevant blocks: "Humanities" (Russian language, Literary reading), "Exact Sciences" (Mathematics), "Aesthetic Education" (Fine Arts and Music). During transition to subject-based education, the "Natural Science" (Natural science) block was added and the "Humanities" block included marks in Literature, History and Foreign Languages.

Psychological testing was carried out in compliance with age characteristics of the children and on the basis of commonly recognised standardised tasks, which make it possible to identify the most frequent changes in the child's behaviour.

This study was approved by the Ethics Committee of the Prof. V.F. Voyno-Yasenetsky Krasnoyarsk State Medical University of the Ministry of Health of the Russian Federation (protocol No. 50/2013 dated February 10, 2011). The research was conducted after signing the Informed Consent by the legal representatives of the child. The study was performed without financial support.

At the first and second stages of the survey (before entering school and at the end of the first year of study), the recommended tests were used (Badina, 2012; Levchenko and Zabramnaya, 2003; Filatova *et al.*, 2017):

1. Activity and independence in cognitive and social activity (the WAM method): the test is widely used to assess the mental state of sick and healthy individuals allowing assessment of wellbeing, activity and mood as well as psycho-emotional response to stress to identify individual characteristics and psycho-physiological functions. It is recommended for work with preschoolers and younger school students with explanation of each pair of words to avoid misunderstanding of the essence of the issue.
2. Focusing and maintaining attention on a specific task according to the Landolt's Correction Test used to study voluntary attention and to assess the pace of psychomotor activity, performance and tolerance to monotonous activity requiring constant concentration of attention.
3. Development of logical and cognitive processes through the method by A.N. Leontieva was used to assess logical memory in healthy children aged 6 to 11 years. With this technique, the capabilities of logical thinking can be assessed.
4. Performing educational actions according to the Toulouse-Pieron test aimed at studying the properties of attention (concentration, stability, switchability) and psychomotor pace with additional assessment of the accuracy and reliability of information assimilation, volitional regulation, personal characteristics and the dynamics of performance over time. A simplified version of the methods was used for children aged 6-8 years, taking into account the age-related sensorimotor development of the children and their smaller amount of operative memory.

During the transition to subject-based learning, testing included the following methods:

1. Emotional-volitional self-regulation and stress tolerance (the "Man in the rain" drawing test by E.S. Romanova, T.I. Sytko): the test is aimed at studying the way of responding, situational behaviour under stress and assessing the ability to overcome adverse situations (the method is applicable from the age of 10).

2. Assessment of trait and state anxiety (Spielberger-Khanin scale, adaptation by Yu. L. Khanin): the test makes it possible to assess the individual significance of a stressful situation for the subject, it is relatively simple and effective and is widely used to determine the severity of anxious experiences.

The results of diagnostic tests were subject to additional scaling of the severity of signs relative to the age norm:

- 0 points - low level (1)
- 1 point - average level (2)
- 2 points - high level (3)

Statistical processing of the material was performed using Microsoft Office Statistica v6.0. The textual and graphical data are presented as absolute numbers and/or percentages characterising the ratio of children with a particular trait. The reliability of the obtained differences in the compared groups was determined using a nonparametric chi-square test. The critical value of the significance level was set at 5% ($p < 0.05$).

Results and Discussion

Analysis of academic performance in the “Humanities” block at stages II and III of observation showed the largest ratio (62%) of children with knowledge compliant with the “good” mark in the control group, as opposite to the prevailing “satisfactory” mark in the RRI group. Students with the “excellent” mark were predominant in the control group as well, thus the number of excellent students at stage III was 2.5-fold higher than in the RRI group. Statistically significant differences were noted between the considered groups in relation to the “good” mark indicating a significant decrease in the number of academically successful children with RRI upon completion of the first year of study ($p=0.018$).

The academic performance in the “Exact Sciences” block demonstrated the best indices in the control group at all stages of observation and a significant decrease in the number of excellent students among the RRI students. Along with this, students with “satisfactory” marks showed 2-fold predominance in the target group during transition to subject-based education. Among children with high he infectious index score, the “excellent” mark was recorded significantly less frequently than in the control ($p=0.008$) at stage II and was absent at stage III.

The results of academic progress in the “Aesthetic Education” block were characterised by the predominance of “good” marks in both groups at all stages of observation. When comparing groups at the

end of the first year of study, excellent results were noted 2 times less often in frequently ill children.

The test assessing activity and independence in cognitive and social activities (the WAM method) showed the highest percentage of the average level of manifestations of the indicator (55-45%) both at the first and the second stages of the survey in both groups ($p=0.023$) and $p=0.002$). Students with low test scores were comparable in both groups at the first stage. However, at the second stage of the study, attention is drawn to the 2-fold increase in the ratio of schoolchildren with low test values in the RRI group. The presented data indicate the specifics of cognitive functions in children with high infectious index at the stage of elementary school and define the need for closer attention to formation of active educational activities.

The testing of schoolchildren using the Landolt's Correction Test at the first and second stages of observation in both groups established the predominance of average values (55-65.2%). While the dynamics of high values in the group with RRI remained unchanged (25%) as opposed to a significant increase in the percentage of schoolchildren in the control group, where the number of the best results of the Landolt's Correction Test increased significantly from 37.5% (first stage) to 62.5% (the third stage) ($p=0.002$). This test made it possible to assess the ability to concentrate, which is one of the main psychological processes, the characteristics of which define the cognitive readiness for schooling and academic performance. However, the realisation of this feature of consciousness requires sufficient and systematic efforts, which may be limited by the decline in somatic wellbeing of the child, especially if these are frequent recurrent illnesses (Shebotinova, 2016; Kovalevsky and Gruzdeva, 2010).

The testing of the development of logical and cognitive processes Leontieva A.N. revealed a significant predominance of average levels of the sign values in the control group at all stages of observation (67.5%) ($p=0.021$ and $p=0.017$). It is important that dynamic assessment of results of this test in the group of subjects with RRI revealed a decrease in the ratio of children showing high results: from 50% (before entering school) to 15% (upon completion of the first year of study) ($p=0.01$). The data obtained indicate lower capabilities of logical thinking, difficulties in fulfilling the tasks set by students who have recurrent infections, absenteeism and adaptation difficulties that may reduce the child's problem-solving ability with the beginning of schooling (Romantsov *et al.*, 2016).

The assessment of the performance of educational actions according to the model and according to the rule based on the Toulouse-Pieron test revealed the predominance of average values (40-50%) in the group with RRI, while high appraisal of results was more frequent in the control group of schoolchildren: up to 57.5% and 50%, respectively ($p<0.001$). Therewith, the ratio of RRI schoolchildren with low values of this indicator increased by 4 times in comparison with the first stage of observation.

The data obtained made it possible to assess the indicators of attention and performance of the child in elementary school and to reveal the problem. This test can be used for further work with the child with the subsequent correction of impairments including measures for recovery in case of RRI.

The subsequent examination using the “Man in the rain” drawing test and the level of anxiety by Spielberger-Khanin were performed once at the third stage during the transition to subject-based education. In children with RRI, a significant predominance of a low level of the test was found in comparison with the control ($p < 0.001$) in the absence of high values of the indicator for the ability to independently resolve conflicts in a peaceful way. The results of testing according to Spielberger-Khanin established the predominance of a high level of anxiety in 70% of schoolchildren with RRI, which was more than 5 times higher than that in the control group, where the largest percentage of children was characterised by a low level of manifestation of this indicator ($p < 0.001$). Schoolchildren with recurrent respiratory infections have higher levels of school anxiety, which is a powerful neurotic factor and may lead to neuropsychic health disorders (Pao and Bosk, 2012; Khalid-Khan *et al.*, 2009).

The identified features of the impact of RRI on the psycho-emotional state of schoolchildren demonstrate the need for close attention to the problem of frequent and recurrent infections, timely comprehensive approach to promotion of health of schoolchildren at the stage of primary education as well as primary psychoprophylaxis with correction of the emotional state with participation of medical workers, teachers, parents and students (Khalid-Khan *et al.*, 2009; Schuch, 2009; Tepper *et al.*, 2015).

Conclusion

The results of academic performance of students with RRI show a statistically significant decrease in the ratio of children with “good” marks (the “Humanities” block), a significant increase in the number of children with the “satisfactory” mark at the end of the first year of study (the “Exact Sciences” block) and a decrease in excellent learning outcomes by 2 times (the “Aesthetic Education” block). The data obtained confirm the reduced educational performance and define the necessity of closer attention to the health status of children with frequent and recurrent infections.

The assessment of higher mental functions of RRI schoolchildren at the stage of primary education based on the results of testing established an increase in the ratio of schoolchildren with low values according to the proposed tests characterising activity and independence in cognitive and social activities (the WAM method), motivation and academic success (the “Landolt’s Correction Test”), the capabilities of logical thinking (the test assessing development of logical and cognitive processes by Leontiev A.N.) and indicators of attention and performance of the child (the Toulouse-Pieron test). The

most significant behavioural features of children with RRI during the transition to subject-based education are a decrease in communication skills (the “Man in the rain” drawing test) and a high level of anxiety (70% of schoolchildren) which is more than 5 times higher than in the control group (the Spielberger-Khanin test). The identified features reveal the need for additional attention of teachers and psychological assistance aimed at development of the necessary psychological qualities in these children in conditions of somatic distress.

Recurrent infectious diseases are therefore among the factors impairing mental functions and the success of schooling and thus requiring an integrated approach of the family, the school and the healthcare to form a healthy and harmonious child.

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