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SENSORIMOTOR REACTIVITY ON DIFFERENT TYPES OF WEATHER IN SECONDARY SCHOOL CHILDREN

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ABSTRACT

The study of age features of higher nervous activity (HNA) neurodynamic characteristics has both theoretical and practical importance. This is one of the important preconditions for understanding formation of integrative brain activity and address a number of pedagogical problems in school with justification of individualization differentiated instruction and education. Especially it is important for children of secondary school, when there is a transition of individuals from childhood to adulthood. Results of our study of sensorimotor reactivity in pupils of secondary school revealed that the worsening of weather conditions occur changes in studied properties: velocity of simple and complex sensorimotor response. We identified age and gender peculiarities of sensorimotor reactivity in different weather conditions which should be considered in differentiation of education and prediction of work efficacy.

KEY WORDS: sensorimotor reactivity, secondary school age, weather.

INTRODUCTION

Practical needs in ergonomics have increased interest to individual characteristics of motor responses different by complexity. When using modern technical devices and systems with a wide flow signals to human body there are major requirements: fast and accurate reception of incoming information; high integrative activity of nerve structures that provide it's processing; response to external stimuli etc.[9]

In modern scientific literature there is enough works, which studied random motor responses (simple sensorimotor reaction - SSR or complex sensorimotor reaction - CSR).[2;3;7;8;10;12;15] There is evidence of sensorimotor reactions like speed characteristics of nervous system and their relationship with functional mobility of nervous processes.[11;15] In addition, some authors studied reaction time depending from physical activity,[7] gender, age and various influences on an organism.[1] There are studies that presenting some characteristics of sensorimotor reactions at different ages[3;7;12] and influence of nature-climatic conditions on some physiological parameters.[2;4;6] However, the impact of weather conditions on sensorimotor reactivity in adolescents remains unexplored and relevant.

The aim of our work was to study sensorimotor reactivity on different types of weather in secondary school children.

MATERIALS AND METHODS

We examined 90 healthy pupils of secondary school (53 girls and 37 boys age of 11 to 13 years old) while different types of weather. Tests were conducted in the morning from 9 am to 12 pm - during the highest human efficiency and optimal conditions for pupils.

Study was conducted under temperate continental climate. According to the Grigoriev's classification[13] weather is divided into 3 types: I, II and III. Information about types of weather during the test we were getting every day from reports of Ternopil meteorological station. Studies were conducted on days with I, II and III types of weather.

Studying individual physiological characteristics of a person by sensorimotor response speed indicators on the load of varying difficulty were performed using computer techniques.[14]

To determine the speed of a simple sensorimotor response (SSR, ms) on computer screen it was shown 100 squares of equal size. When they appear needed as soon as possible press any letter of the keyboard. To

determine the speed of complex sensorimotor response (CSR, ms) two types of images appeared on screen: square and triangle. In total 100 pieces. When square - right hand had to press "/", if triangle - left hand had to press "Z".

Statistical processing of obtained results was carried out by nonparametric statistical methods.

RESULTS AND DISCUSSION

Study of SSR speed in secondary school pupils when different weather conditions indicate that in 11-years-old pupils was observed only a trend towards its decrease with worsening weather conditions. For example, if with first type of weather it amounted to (302.78 ± 18.32) ms, then the second - (318.30 ± 19.20) ms, while the third (372.88 ± 39.04) ms. In 12-years-old pupils the speed of SSR was: during I type of weather - (283.25 ± 33.46) ms, during II - (318.72 ± 24.60) ms and during III - (357.32 ± 29.95) ms. In 13-years-old pupils the speed of a simple sensorimotor reaction also had tendency to reduce with deterioration of meteorological situation. During first type of weather in was (272.86 ± 19.99) ms, during second - (306.44 ± 25.68) and during third - (312.56 ± 21.51) ms.

Thus, 11, 12 and 13-years-old pupils were resistant to the negative impact of weather, as there only been observed a tendency to reduce the speed of SSR with deterioration of weather conditions.

Studies of SSR speed during different weather conditions (Table 1) in girls and boys indicate that 11-years-old girls SSR speed with deteriorating of meteorological situation didn't change. This means they were resistant to the negative impact of weather conditions. In boys 11-years-old speed of simple sensorimotor reaction decreased significantly during meteorological type III compared with same indications during weather type I ($P_{I-III}<0.05$). When comparing these indicators for I and II or II and III types of weather significant differences were not found.

In 12-years-old girls and boys there was a tendency to decrease the speed of simple sensorimotor reaction with deterioration of weather conditions. In 13-years-old girls there was a decrease in speed of SSR in the third type of weather versus its values with meteorological type I (PI-III <0.05), while comparing these parameters of weather types I and II also II and III the significant differences were not found. 13-years-old boys had tendency in decrease of SSR speed with worsening of weather conditions.

Table 1: Speed of simple sensorimotor reaction in boys and girls of secondary school during different types of weather, ms.

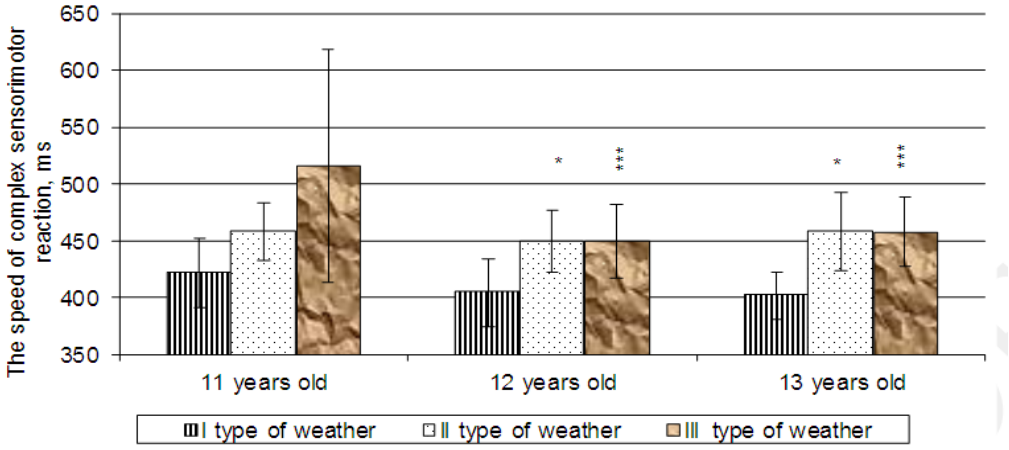
Age (years) and number of tested pupils	Type of weather	Girls	Boys
11 (n♀=17) (n♂=13)	I II III	281.66±14.20 304.10±20.79 358.76±39.66	323.90±22.44 332.50±17.61 386.99±25.41■■■
12 (n♀=18) (n♂=12)	I II III	298.56±31.66 323.52±24.68 360.25±26.80	267.94±35.25 313.92±24.51 354.39±33.10
13 (n♀=18) (n♂=12)	I II III	240.87±10.83**(11-13 year old) 270.08±22.14 277.96±10.22■■■, **(11-13 year old) and (12-13 year old)	304.84±25.14* 342.79±29.22* 347.16±27.79*

Notes:
1. ■ – P<0.05 – comparison during I and II types of weather.
2. ■■■ – P<0.05 – comparison during I and III types of weather.
3. * – P<0.05 comparison of same age girls and boys during same type of weather.
4. ** – P<0.05 for different age girls during the same type of weather.

Table 1 shows that in 11-12-years-old girls didn't had significant differences in SSR speed during I, II and III types of weather. Moreover in 12-years-old girls SSR speed was lower compared with 13-years-old schoolgirls only during third type of weather ($P_{III (12\text{-}13 \text{ years old})}<0.05$). When comparing results of 11- and 13-years-old girls it was found significantly higher SSR speed in 13-years-old schoolgirls compared to the same values in 11-years-old girls during I and III types of weather ($P_{I(11\text{-}13 \text{ years old})}<0.05$; $P_{III(11\text{-}13 \text{ years old})}<0.05$). When comparing results obtained in 11-13-years-old boys during similar weather conditions not big age differences between studied parameters were found.

Results of our research (Table 1) indicate that 11 and 12-years-old girls and boys didn't had significant differences in speed of simple sensorimotor reaction during same types of weather. Speed of SSR in 13-years-old girls was higher compared to 13-years-old boys during the same weather conditions.

Results of CSR speed in adolescents during different types of weather are presented in Figure 1.



Notes: 1. * – P<0.05 – comparison during I and II types of weather.
2. *** – P<0.05 – comparison during I and III types of weather.

Figure 1: Speed of complex sensorimotor reaction (CSR, ms) in adolescents during different types of weather.

During registration of responses in 11-13-years-old pupils CSR latent periods were significantly longer compared with SSR latent periods.

11-years-old pupils have tendency to reducing speed of complex sensorimotor reaction with deterioration of weather conditions (Figure 1). Thus, with I type of weather it was (422.11 ± 13.41) ms, during II type of weather it decreased to (457.93 ± 12.68) ms and with III type it was (516.19 ± 46.56) ms. In 12-years-old pupils CSR speed was as follows: with I type of weather - (404.52 ± 15.88) ms, with II - (449.88 ± 13.60) ms, during III type - (450.15 ± 16.26) ms (P_{I-II} <0.05; P_{II-III}> 0.05; P_{I-III} <0.05). In 13-year-old adolescents results of CSR speed were: with I type of weather - (402.11 ± 10.46) ms, with II type - (457.74 ± 17.23) ms and during III type - (458.26 ± 15.36) ms (P_{I-II} <0.05; P_{II-III}> 0.05; P_{I-III} <0.05).

Results of our research indicate that in 11-years-old pupils there was a tendency to decrease in speed of CSR during deterioration of weather conditions. At the age of 12- and 13-years-old adolescents had higher speed of CSR during I type of weather compared to II and III types.

Studies of CSR speed in boys and girls during the same weather conditions (Table 2) indicate that in 11-years-old girls had decreased speed of complex sensorimotor reactions during III type of weather in comparison with I type (P_{I-III} <0.05). When comparing these indicators for I and II or II and III types of weather significant differences were not found. In 11-years-old boys there was a tendency to decrease in speed of CSR during deterioration of weather conditions, which means they were more resistant to meteorological situation.

Table 2: Speed of complex sensorimotor reaction in boys and girls of secondary school during different types of weather, ms

Age (years) and number of tested pupils	Type of weather	Girls	Boys
11	I	395.21±22.94	440.05±15.91
(n♀=17)	II	434.18±16.08 ■	473.77±17.91
(n♂=13)	III	558.13±95.79 ■■■	488.23±48.42
12	I	377.98±26.92	422.22±19.54
(n♀=18)	II	431.87±29.54 ■	461.89±16.85 *
(n♂=12)	III	436.63±29.24 ■■■	459.16±19.96
13	I	383.63±13.30	416.24±15.14
(n♀=18)	II	421.95±22.19	485.10±24.16 ■,*
(n♂=12)	III	428.00±18.54 **(11-13 years old)	481.41±22.36 ■■■, *

Notes:
1. ■ – P<0.05 – comparison during I and II types of weather.
2. ■■■ – P<0.05 – comparison during I and III types of weather.
3. * – P<0.05 comparison of same age girls and boys during same type of weather.
4. ** – P<0.05 for different age girls during the same type of weather.

12-years-old girls had significantly lower speed of CSR during meteorological type III compared to type I (P_{I-III} <0.05), also the speed was lower during second type of weather compared to first (P_{I-II} <0.05). When comparing these indicators for II and III types of weather significant differences were not found. It was no significant differences in speed CSR in 12-years-old boys during different types of weather. 13-years-old girls had tendency in decrease of CSR speed with worsening of weather conditions. 13-years-old boys had significant decrease of CSR speed during III type of weather compared to I type (P_{I-III}<0.05), also the speed was lower during II type of weather compared to first (P_{I-II} <0.05). When comparing these indicators for II and III types of weather significant differences were not found.

Table 2 shows that when comparing results of CSR in 11- and 13-years-old girls found significantly higher speed of CSR in 13-years-old schoolgirls compared to 11-years-old girls during only III type of weather ($P_{III(11-13\ years\ old)}$ < 0.05). When comparing results obtained in 11-13-years-old boys during similar weather conditions not big age differences between studied parameters were found.

Results of our research (Table 2) indicate that 11-years-old girls and boys didn't had significant differences in speed of complex sensorimotor reaction during same types of weather. In 12-years-old girls CSR speed was higher compared to boys during only II type of weather. Speed of CSR in 13-years-old girls was higher compared to 13-years-old boys during II and III types of weather.

Our results (Table 1) show that secondary school children had tendency to decrease of SSR speed with worsening of weather conditions. 12-13-years-old pupils had significant decrease of SSR speed. 11-years-old pupils had only tendency to decrease of SSR speed during worsening of meteorological situation. Thus, when the task becomes more difficult, the more significant was decrease in speed of sensorimotor reactions. These findings are consistent with the studies of MV Makarenko, AM Ivanytskiy, EI Boyko.[1, 5, 9]

CONCLUSION

1. Simple sensorimotor reaction has a tendency to decrease in 11-13-years-old pupils during worsening of weather.
2. Complex sensorimotor reaction significantly decreases only in 12-13-years-old pupils during II and III types of weather.
3. Sensorimotor reaction has certain gender specifics during worsening of weather.

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