HUMAN, TECHNOLOGIES AND QUALITY OF EDUCATION, 2025
https://doi.org/10.22364/htqe.2025.42

RELATIONSHIPS BETWEEN MOTOR AND PSYCHOPHYSIOLOGICAL ABILITIES IN ADOLESCENTS WITH MILD MENTAL DISORDERS

Juris Porozovs[1], Viktors Veliks[1], Vita Lakša[2], Aija Kļaviņa[3], Anna Zuša[3]

[1]University of Latvia, Latvia
[2]Riga 5th Primary School – Development Center, Latvia
[3]Riga Stradiņš University, Latvia

ABSTRACT

Mental health disorders limit a person's ability to work and take full care of themselves. In the adolescent period, children with mild mental health disorders need to have a good sleep regimen, to develop the ability to control emotions, and to regularly engage in sports activities. The aim of the work was to study the correlations between motor and psychological abilities in 11–16-year-old adolescents with mild mental health disorders. The motor abilities of 12 adolescents with mild mental health disorders were assessed with the Bruininks-Oseretsky Motor Development Test (Part 2), and psychophysiological parameters were determined using the Vienna Test System. The relationship between the motor abilities of adolescents and the indicators of psychophysiological parameters was assessed using the Pearson correlation coefficient method. The results of the study showed that the motor skills of adolescents with mild mental health disorders were below the average level of development, but in balance exercises, they were very low. The results of the Vienna tests were divided into 2 groups: the results of 11–14-year-old adolescents and the results of 15–16-year-old adolescents, based on the observations that the attitude of the two groups towards the performance of the Vienna tests was different. Older group adolescents performed work more slowly, but more carefully and accurately, completing the test tasks. Adolescents of the younger group were characterized by chaotic activity and the inability to concentrate on work for a long time. The results of the correlation analysis showed that there is a correlation between separate indicators of motor development and psychophysiological parameters; therefore, physical activities play an essential role in the prevention and treatment of mental health disorders in adolescents.

Keywords: *adolescents, mild mental disorders, motor abilities, physical activities, psychophysiological parameters*

Introduction

Mild mental disorders in adolescents are an important social problem that affects adolescents, their parents, and educators. Worldwide, 10% to 20% of children and adolescents are diagnosed with mental or behavioral disorders, and especially during adolescence, the risk of developing various mental health and emotional disorders increases significantly (Kieling et al., 2011). 50% of all adult mental disorders have their onset in adolescence (Belfer, 2008). Intellectual disabilities affect cognitive, language, motor, and social skills. They affect the overall level of intelligence, cause learning difficulties, and slow down the child's development. The degree of mental disorders is determined using standardized intelligence tests. According to the International Classification of Diseases, mild mental disorders (mild mental disability) are designated by the code F 70 (International Statistical Classification of Diseases and Related Health Problems, 2019). The approximate Intellectual Coefficient (IQ) for children with mild mental disorders ranges from 50 to 69. Intellectual abilities and social adaptation can change over time and, although lagging behind the average level, can improve as a result of training and rehabilitation. In adulthood, in many cases, despite mild intellectual disabilities, a person will be able to work and maintain good social relationships and contribute to society (International Statistical Classification of Diseases and Related Health Problems, 2019).

For children with mild mental disability, it is difficult to determine when adolescence ends and when the young adult period begins. For some adolescents or young people with mild mental disorders, the onset of the characteristic old age is delayed by one or two years. Adolescents with mild mental disability often experience irritability, unmotivated mood swings, and loss of interest, and sometimes they could be characterized by insistence, persistence, or satisfaction of selfish interests. Adolescents need to be accepted by their peers. Social skill interventions are effective measures to reduce the risk of developing mental disorders for children with mental disability (Adeniyi & Omigbodun, 2016). The implementation of psychological and pedagogical follow-up programs can be used to prevent the antisocial behavior of adolescents with mild mental disorders. The task of educators is to teach their students a love of work and to promote social adaptation (Keenan et al., 2025). An important task for educators is to choose the right teaching and learning methods and systematically monitor and evaluate students' acquisition of social skills.

Sports activities are a significant factor in improving the functioning of children with mild mental disability (Ghosh & Datta, 2012). Research indicates that a person's physical fitness and state significantly impact their psychophysiological parameters (Podrigalo et al., 2019). For many people with disabilities, postural and gait abnormalities are a direct result of a deterioration in their posture or body balance and postural stability. In students with developmental disabilities, these problems appear in early motor development, when walking, climbing stairs, or in stereotyped gait movements (Cech & Martin, 2012). Children with coordination disorders have lower muscle strength and an inability to maximize force and change force-velocity and tolerance. Their physical

development is relatively lower than their peers who do not have similar health problems (Farhat et al., 2015). Simple movements such as walking and running help maintain good posture. Physical activity should be encouraged to prevent limb immobility and joint stiffness. If an individual does not develop a combination of activities for developing strength and stability, it is difficult to achieve coordinated movement (Horvat et al., 2019). Regular physical activities adapted to the child's individual needs and age positively affect the child's cognitive and physical growth and maturation, but childhood physical activity contributes to better health and well-being in adulthood (Kostecka et al., 2017). It is found that a healthy lifestyle is related to fewer subjective somatic and psychological complaints (Klavina et al., 2021). Physical activity promotes healthy living, as well as integration into society and the school environment. This can result in a sense of well-being that promotes self-esteem and self-confidence. One of the main goals of physical activity is to ensure that every individual has the opportunity and desire to be physically active, which becomes a part of their lifestyle (Horvat et al., 2019).

The aim of the work was to study the correlations between motor and psychological abilities in 11–16-year-old adolescents with mild mental health disorders.

Methodology

Participants

The study was carried out at Riga Special Education Primary School – Development Center. The motor abilities and psychophysiological parameters of 11–16-year-old adolescents with mild mental disorders were determined. 12 adolescents who studied at a special education primary school according to the special education program with the code 21015811 were appreciated. The relationship between the motor abilities of adolescents and the psychophysiological parameters was assessed.

Bruininks – Oseretsky Bot-2 test

The motor skills of adolescents were assessed using the Bruininks – Oseretsky Bot-2 method (Bruininks & Bruininks, 2005). The Bruininks-Oseretsky test is individually developed for measuring different motor abilities, in which targeted and effective tasks are performed to assess the development of small and large motor skills in people aged 4 to 21 years. Using the Bruininks – Oseretsky Bot-2 test, it is possible to determine the state of an individual's physical fitness and the delay in the development of motor abilities according to the age of the child. Movement skills were assessed using four subtests of the Bruininks – Oseretsky Test of Motor Proficiency II (BOT-2): 1) upper body bilateral coordination (7 tasks), 2) balance (9 tasks), 3) speed (5 tasks), and 4) strength (5 tasks).

The upper body bilateral coordination tasks were: 1) touching the nose with the index finger – eyes closed; 2) jumping jacks; 3) jumping in place – same sides synchronized; 4) jumping in place – opposite sides synchronized; 5) pivoting thumbs and index fingers; 6) tapping feet and fingers – same sides synchronized; 7) tapping feet and fingers – opposite sides synchronized.

The balance tasks were: 1) standing with feet apart on a line –eyes open; 2) walking forward on a line; 3) standing on one leg on a line – eyes open; 4) standing with feet apart on a line – eyes closed; 5) walking forward heel–to–toe on a line); 6) standing on one leg in a line – eyes closed; 7) standing on one leg on a balance beam – eyes open; 8) standing heel–to–toe on a balance beam; 9) standing on one leg on a balance beam – eyes closed.

The speed tasks were: 1) shuttle runs; 2) stepping sideways over a balance beam; 3) one-legged stationary hop; 4) one-legged side hop; 5) two-legged side hop.

The strength tasks were: 1) standing long jump; 2) full push-ups/knee push-ups; 3) sit-ups; 4) wall sit; 5) V-up.

The total point scores of the four subtests were calculated and converted to scale scores, standard scores, percentiles, age-equivalents, and descriptive categories for each subtest.

Vienna tests

Students' psychophysiological parameters were assessed using the Vienna tests. The Vienna Test System (VTS) is one of the leading computerized psychophysiological assessment methods developed by Austrian scientists, which includes a variety of tests covering different aspects of psychophysiological assessment and diagnosis. The tests have high values of validity and reliability, which have been confirmed by specially performed studies at the test development company "Schufrried" in Vienna (The Vienna Test System. Schuhfried, 2025).

The following Vienna tests were used: Adaptive Matrices Test (AMT), Cognitrone test (COG), Determination Test (DT), Figural Memory Test (FGT), Reaction Time Test (RT06), and STROOP Test (STROOP).

The AMT test is a non-verbal test that assesses general intelligence in terms of logical reasoning. In each test stage, 9 squares are displayed, which appear in the upper part of the screen. Eight of the squares contain geometric figures, and the last square contains a question mark. The 8 figures are interconnected by certain regularities. The respondent's task is to identify these regularities and replace the "?" sign (logically correct) with one of the figures shown below the squares. This test provides information about the respondent's level of non-verbal intelligence.

The COG test describes a person's work style, the speed of information processing, the persistence of attention, and the ability to focus on work. During the test, the respondent must compare various figures and decide on their identity.

The DT test is used for the measurement of reactive stress tolerance (stress resilience) and the ability to react in difficult situations under complex stimulus conditions. During the test, visual and acoustic signals are presented at high speed, to which a person must respond as quickly as possible, and an appropriate response must be given. The test results can be used to assess an individual's ability to work under stress.

The FGT test is used to assess episodic memory for shape recall and shape learning. The first part of the test consists of five stages of shape presentation and reproduction, in which 9 shapes are repeatedly presented. Immediately after each stage of shape

presentation, the shapes must be reproduced using computer mouse clicks on the screen. After a 5-minute break, the second part of the test follows, during which the shapes must be reproduced without being shown. The third part of the test involves the reproduction of shapes after a 30-minute break. After that, it is necessary to recognize which shapes have been previously presented and which have not been previously presented.

The RT06 test is used to assess the ability to respond to simple stimuli with both the right and left hands.

The STROOP test is a sensorimotor speed test that measures speed in reading words and naming colors under conditions of color/word interference. The respondent in the first part of the test must react according to the meaning of the written word (reading words), but in the second part of the test, a person must react according to the color of the written word (naming words) (see Figure 1). The STROOP test assesses the ability to inhibit cognitive interference that occurs when the processing of a specific stimulus feature impedes the simultaneous processing of a second stimulus attribute.

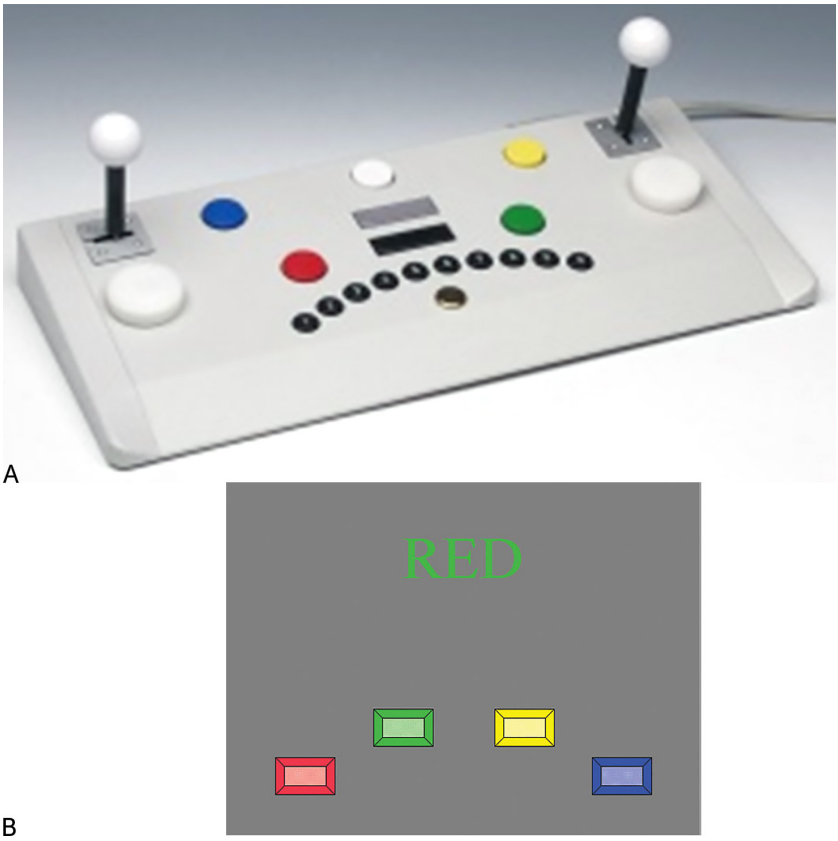

Figure 1 Vienna tests panels

A. The computer panel of the Vienna tests. B. Sensory response assessment during the STROOP test in response to the color of the word

Statistical analyses

The obtained data in the research were processed using the "Microsoft Office Excel" program and the "Microsoft Office Excel" add-in "Statistics 3.11." and SPSS – Statistical Package for the Social Sciences (SPSS Version 28). The correlation analysis was assessed using the Pearson correlation coefficient method (Pelšs, 2015).

Results

Bruininks-Oseretsky Test (BOT-2) results

Assessing the physical parameters of adolescents with mild mental disorders, the obtained results were compared with the parameters of the corresponding age group. It was assessed whether the physical parameters were appropriate for the age group or whether they lagged behind the parameters of the characteristic age group. The age group to which the level of physical fitness of adolescents corresponds was assessed (see Table 1).

The average age of the study group was 13.01 years. According to the BOT-2 tests, the results of motor abilities showed that the coordination of upper body movements in adolescents with mild mental disorders corresponded on average to 8.17-year-old children (lagging behind the norm by 4.84 years). The balance parameters in adolescents with mild mental disorders corresponded on average to the results of 11.32-year-old children (the age difference with the norm was 1.69 years). The speed results of adolescents with mild mental disorders corresponded to the results of 8.79-year-old children (the age difference from the norm was 4.22 years). The strength results of adolescents with mild mental disorders corresponded to the results of 10.36-year-old children (lagging behind the norm by 2.65 years). The results of the study showed that the motor abilities of adolescents with mild mental disorders were below the average level of development, especially lagging behind the norm in coordination and speed parameters.

Table 1 Average ages of adolescents with mild mental disorders according to motor abilities assessed by Bruininks-Oseretsky Motor Development Test (Part 2) results

Parameters	*n*	Minimum value	Maximum value	Average age of the group (years)	The age difference with the norm (years)
Age	12	11	16	13.01	
Upper body bilateral coordination	12	6	11	8.17	4.84
Balance	12	6	18	11.32	1.60
Speed	12	5	14	8.79	4.22
Strength	12	7	18	10.36	2.65

Vienna Test results

Adolescents with mild mental disorders, when analyzing the results of the Vienna tests, were divided into 2 groups: 11–14-year-old students (7 students) and 15–16-year-old students (5 students). The division into age groups was made based on observations that the behavior and attitude of the two groups of students towards the performance of the Vienna tests differed. The results of the Vienna tests of both groups of students were compared with each other and with the results of the entire group.

The results of the Vienna Adaptive Matrix Test (AMT) (see Table 2) showed that 15–16 years old adolescents with mild mental disorders made fewer errors during the test (the average number of correct answers in the group was 7 ± 4.3 and the number of errors was also 7 ± 4.3) than 11–14 years old adolescents with mild mental disorders (the average number of correct answers in the group was 4.43 ± 1.99, but the number of errors was 9.57 ± 1.99). The average IQ for the older group of adolescents was –2.75 ± 1.96, but for the younger group of adolescents, it was –3.41 ± 0.77. These scores are below the norm for both groups, but they are better for the older group of adolescents. The percentage IQ for the older group of students was also significantly higher (18 ± 19.33) than for the younger group of students (2.43 ± 3.05). When analyzing the results, it should be noted that the tested students have mild mental disorders, therefore the average IQ scores in both groups are low, however, for the older group of students they are significantly higher, and observing the behavior of the students, it was noted that the students of this group were better able to mobilize themselves to complete the test.

Also, in the Vienna Cognitron Test (COG), the number of correct answers from the older group of adolescents with mild mental disorders was significantly higher (50.4 ± 9.34) than the number of correct answers from the younger group of adolescents (46.29 ± 10.55), and the older group of adolescents made fewer errors in comparison with the younger group of adolescents (see Table 3). In turn, the average reaction time of the younger group adolescents was significantly shorter both for correct answers (2.58 ± 1.63 s) and for incorrect answers (2.3 ± 1.27 s) than for the older group adolescents (3.17 ± 1.25 s for correct answers and 3.8 ± 1.75 s for incorrect answers). The results show that the younger group of adolescents worked faster but less accurately.

Table 2 Vienna Test – Adaptive Matrix Test (AMT) results for adolescents with mild mental disorders ($M \pm sd$*)

Age	Number of correct answers	Number of mistakes	Intelligence score	Intelligence percentage
11–14	4.43 ± 1.99	9.57 ± 1.99	–3.41 ± 0.77	2.43 ± 3.05
15–16	7 ± 4.3	7 ± 4.3	–2.75 ± 1.96	18 ± 19.33
The whole group 11–16	5.5 ± 3.26	8.5 ± 3.26	–3.14 ± 1.36	8.92 ± 14.32

*M – mean of group results; sd – standard deviation

Table 3 Vienna Test – Cognitrone Test (COG) results for adolescents with mild mental disorders ($M \pm sd$*)

Age	Number of correct answers	Number of incorrect answers	Reaction time to correct answers (s)	Reaction time to incorrect answers (s)
11–14	46.29 ± 10.55	13.71 ± 10.55	2.58 ± 1.63	2.3 ± 1.27
15–16	50.4 ± 9.34	9.6 ± 9.34	3.17 ± 1.25	3.8 ± 1.75
The whole group 11–16	48 ± 9.84	12 ± 9.84	2.83 ± 1.46	2.93 ± 1.61

*M – mean of group results; sd – standard deviation

Table 4 Vienna Test – Determination Test (DT) results for adolescents with mild mental disorders ($M \pm sd$*)

Age	Number of correct reactions	Number of incorrect reactions	Number of omitted reactions	Median of reaction time to stimuli (s)	Total number of reactions	Total number of stimuli
11–14	137.25 ± 47.73	31.88 ± 19.37	24.13 ± 7.7	1.01 ± 0.1	169.13 ± 42.28	169.13 ± 55.2
15–16	185 ± 20.33	23.2 ± 18.24	21.4 ± 4.98	0.92 ± 0.1	212.8 ± 21.65	208.2 ± 25.78
The whole group 11–16	155.62 ± 45.29	28.54 ± 18.68	23.08 ± 6.69	0.98 ± 0.11	185.92 ± 41.09	184.15 ± 48.89

*M – mean of group results; sd – standard deviation

The results of the Vienna Determination Test (DT) show that the older group adolescents with mild mental disorders had significantly more correct reactions (185 ± 20.33) but less errors (23.2 ± 18.24) and omitted reactions (21.4 ± 4.98) than the younger group adolescents (respectively, the number of correct reactions was 137.25 ± 47.73, the number of incorrect reactions was 31.88 ± 19.37 and the number of omitted reactions was 24.13 ± 7.7) (see Table 4). The median of reaction time to stimuli was slightly shorter for the older group adolescents (0.92 ± 0.1 s) than for the younger group adolescents (1.01 ± 0.1 s). The older group of adolescents made more reactions during the test, so they worked more efficiently.

Performing the Vienna Figure Memory Test (FGT) (see Table 5), the total number of correctly reproduced figures during the demonstration of a series of 5 figures was significantly higher for adolescents with mild mental disorders from the older group (22 ± 10.58) than for adolescents from the younger group (15 ± 6.3). After a 5-minute break, the older group of adolescents was able to reproduce more figures (4.8 ± 3.35) than the younger group of adolescents (2.29 ± 2.5). However, after a 30-minute break, the younger group of adolescents showed even better results than the older group of adolescents (on average, 4.1 ± 2.18 figures were correctly reproduced by adolescents in the younger group, while 3.5 ± 2.17 were reproduced by adolescents in the older group). When performing figure recognition, adolescents from both groups showed the same results (adolescents from the older group correctly recognized 13 ± 1.63 figures, while

adolescents from the younger group correctly recognized 13 ± 2.76 figures). The results suggest that the ability to retain figures in memory is not weaker in the younger group of adolescents in comparison to the older group of adolescents, as evidenced by the relatively good results in figure recognition and reproduction after a 30-minute break but the ability to concentrate on work is a major difficulty for adolescents from the younger group.

The results of the Reaction Time Assessment Test (RT06) (see Table 6) showed that the younger group of adolescents with mild mental disorders reacted significantly faster to a simple stimulus with both the right hand (358.88 ± 131.62 ms) and the left hand (414.63 ± 145.75 ms) than the older group of adolescents with mild mental disorders (respectively, the average reaction time with the right hand was 451.2 ± 326.93 ms and 495.2 ± 96.6 ms with the left hand). At the same time, it should be noted that the younger group of adolescents made more errors – they did not respond to all stimuli, responding with both the right hand and the left hand. The obtained results show that the younger group of adolescents worked faster, but less accurately than the older group of adolescents.

Table 5 Vienna Test – Figure Memory Test (FGT) results for adolescents with mild mental disorders ($M \pm sd$*)

Age	1	2	3	4	5	6	7
11–14	15 ± 6.3	2.29 ± 2.5	1.29 ± 1.38	4.1 ± 2.18	2.5 ± 4.23	13 ± 2.76	5 ± 2.76
15–16	22 ± 10.58	4.8 ± 3.35	2.6 ± 3.29	3.5 ± 2.17	2.5 ± 1.91	13 ± 1.63	5 ± 1.63
The whole group 11–16	17.92 ± 8.68	3.33 ± 3.03	1.83 ± 2.33	5 ± 2.16	2.5 ± 3.34	13 ± 2.26	5 ± 2.26

**M* – mean of group results; *sd* – standard deviation.

1 – Total number of correctly reproduced figures during the 5-figure series demonstration; 2. – Number of correctly reproduced figures after a 5-minute break; 3 – Number of incorrectly recognized figures after a 5-minute break; 4 – Number of correctly reproduced figures after a 30-minute break; 5 – Number of incorrectly recognized figures after a 30-minute break; 6 – Number of correctly recognized figures during the figure demonstration after a 30-minute break; 7 – Number of incorrectly recognized figures during the figure demonstration after a 30-minute break

Table 6 Vienna Test – Vienna Test – Reaction Time Assessment Test (RT06) results for adolescents with mild mental disorders ($M \pm sd$*)

Age	Average reaction time (ms)	Average movement reaction time (ms)	Number of correct reactions	Number of omitted reactions	Number of incomplete reactions
11–14	358.88 ± 131.62	98.63 ± 1.85	1.38 ± 1.85	414.63 ± 145.75	97.88 ± 3.98
15–16	451.2 ± 326.93	100 ± 0	0 ± 0	495.2 ± 96.6	99.8 ± 0.45
The whole group 11–16	394.38 ± 218.9	99.15 ± 1.57	0.85 ± 1.57	445.62 ± 126.85	98.62 ± 3.2

**M* – mean of group results; *sd* – standard deviation

Table 7 Vienna Test – Stroop test (interference test) (STROOP) (word reading test part) results for adolescents with mild mental disorders ($M \pm sd$*)

Age	1	2	3	4	5	6	7
11–14	1.09 ± 0.22	1.06 ± 0.2	1.2 ± 0.41	32.43 ± 36.28	2.29 ± 3.09	30.14 ± 33.27	0.14 ± 0.27
15–16	1.4 ± 0.52	1.45 ± 0.68	1.5 ± 0.66	17.2 ± 32.9	3 ± 6.16	14.2 ± 26.76	0.05 ± 0.14
The whole group 11–16	1.22 ± 0.39	1.22 ± 0.48	1.32 ± 0.52	26.08 ± 34.25	2.58 ± 4.38	23.5 ± 30.52	0.1 ± 0.22

*M – mean of group results; sd – standard deviation

1 – Median of reaction time during all word reading (ms); 2 – Median of reaction time during congruent word reading (ms); 3 – Median of reaction time during incongruent word reading (ms); 4 – Number of errors during all word reading; 5 – Number of errors during congruent word reading; 6 – Number of errors during incongruent word reading; 7 – Word reading interference trend

The Vienna STROOP test consists of two parts: in the first part, the respondent must respond to the word, taking into account its meaning (word reading test), and in the second part, the respondent must respond to the color of the word, regardless of its meaning (word color assessment part).

In the STROOP word reading test part (see Table 7), the younger group of adolescents with mild mental disorders showed a shorter response time median (1.09 ± 0.22 ms) in comparison with adolescents of the older group (1.4 ± 0.52 ms). At the same time, it should be noted that adolescents in the younger group made more errors (32.43 ± 36.28) than the adolescents in the older group (17.2 ± 32.9). In particular, many errors were made by adolescents of the younger group in response to non-congruent words (words that differed in meaning and color) (30.14 ± 33.27). In response to congruent words (words that matched the meaning of the word and the color of the word), there were fewer errors (2.29 ± 3.09). These findings suggest that adolescents in the younger group often did not delve into test performance rules during word reading, did not fully read the words, and often responded not to the meaning of the word they wrote but to its color. Consequently, the trend of word-reading interference among younger adolescents was very high (0.14 ± 0.27). Adolescents in the older group also made more errors in reading non-congruent words (14.2 ± 26.76) than congruent words (3 ± 6.16), but this difference was smaller than for adolescents in the younger group, resulting in a lower trend of reading interference (0.05 ± 0.14).

In the STROOP color assessment test part (see Table 8), the reaction times of the younger and older groups of adolescents with mild mental disorders did not differ much. They were slightly shorter for the younger group of adolescents (0.99 ± 0.12 ms) than for the older group of adolescents (1.03 ± 0.27). The number of errors was higher for the younger group of adolescents (13.71 ± 13.56) than for the older group of adolescents (7 ± 9.08). When responding to incongruent words, both the younger and older groups of students made more errors than when responding to congruent words but the interference tendency for color evaluation was the same for the students of both groups (0.07 ± 0.06 for the younger group of students, and 0.07 ± 0.13 for the older group of students).

Table 8 Vienna Test – Stroop Test (STROOP) (word color assessment part) results for adolescents with mild mental disorders ($M \pm sd$*)

Age	1	2	3	4	5	6	7
11–14	0.99 ± 0.12	0.95 ± 0.09	1.03 ± 0.12	13.71 ± 13.56	3 ± 3.96	10.71 ± 9.76	0.07 ± 0.06
15–16	1.03 ± 0.27	0.98 ± 0.21	1.05 ± 0.3	7 ± 9.08	2 ± 2.92	5 ± 6.2	0.07 ± 0.13
The whole group 11–16	1.01 ± 0.19	0.96 ± 0.14	1.04 ± 0.2	10.92 ± 11.93	2.58 ± 3.45	8.33 ± 8.64	0.07 ± 0.09

*M – mean of group results; sd – standard deviation

1 – Median of reaction time during the color evaluation of all words (ms); 2 – Median of reaction time during the color evaluation of congruent words (ms); 3 – Median of reaction time during the color evaluation of incongruent words (ms); 4 – Number of errors during the color evaluation of all words; 5 – Number of errors during the color evaluation of congruent words; 6 – Number of errors during the color evaluation of incongruent words; 7 – Interference tendency of color evaluation

Correlation analysis of physical (motor) parameters of Bruininks-Oseretsky Test (BOT-2) results, and psychophysiological parameters (Vienna Test results) of students with mild mental disorders

A correlation analysis (using the least squares algorithm) was performed for the most characteristic parameters of the Vienna Tests of adolescents with mild mental disorders, with the total scores of the BOT-2 test for assessing physical (motor) development.

A high correlation between the indicators can be considered if the correlation coefficient r is greater than 0.75. The second factor that determines the choice of the regression form is the coefficient of determination or the correlation coefficient squared (R^2) (R-squared). The closer the R^2 value of the coefficient of determination is to 1, the better the model described by the given linear regression equation (Pelšs, 2015).

Adaptive Matrix (AMT) Vienna Test Intelligence scores (see Table 9) for the younger group of adolescents with mild mental disorders (11–14 years old) show a certain correlation (the correlation coefficient r value is 0.606) with the total results of the BOT-2 test of motor development. These results indicate that there is a certain positive correlation between the general intelligence of the younger group of adolescents and motor development. In the older group of adolescents, such a correlation was not observed, which can be explained by the fact that the older group of adolescents was more heterogeneous.

The number of correctly assessed figures in the Cognitron Vienna test (COG) for adolescents with mild mental disorders in the younger group correlates to some extent with the total results of the BOT-2 test of motor development (the correlation coefficient r is 0.73, which is close to the result of a close correlation) (see Table 9).

Table 9 Correlation of the Vienna Test results and Bruininks-Oseretsky Test (BOT-2) results of adolescents with mild mental disorders

Test parameters	Age	Linear regression equation and coefficient of determination, R^2	Correlation coefficient, r
AMT the intelligence scores	11–14	$y = 0.035x - 7.047$ $R^2 = 0.367$	0.606
	15–16	$y = -0.091x + 7.967$ $R^2 = 0.111$	−0.333
	The whole group 11–16	$y = 0.024x - 5.785$ $R^2 = 0.051$	0.226
COG the number of correctly assessed figures	11–14	$y = 0.521x + -9.714$ $R^2 = 0.533$	0.730
	15–16	$y = -0.208x + 78.32$ $R^2 = 0.085$	−0.292
	The whole group 11–16	$y = 0.484x - 4.663$ $R^2 = 0.443$	0.665
DT the number of correct answers	11–14	$y = 1.849x - 50.655$ $R^2 = 0.492$	0.701
	15–16	$y = -0.798x + 279.309$ $R^2 = 0.08$	−0.282
	The whole group 11–16	$y = 1.839x - 42.417$ $R^2 = 0.425$	0.652
DT the number of omitted answers	11–14	$y = -0.42x + 68.187$ $R^2 = 0.673$	−0.820
	15–16	$y = -0.573x + 89.074$ $R^2 = 0.683$	−0.827
	The whole group 11–16	$y = -0.389x + 65.909$ $R^2 = 0.621$	−0.788

The number of omitted responses in the Determination Vienna Test (DT) test (see Table 9) shows a close negative correlation with the number of omitted responses both for the younger group of adolescents (correlation coefficient r is −0.820), for the older group of adolescents (correlation coefficient r is −0.827), and for the entire group of adolescents (correlation coefficient r is −0.788). These results show that adolescents with better physical fitness have fewer omitted responses in all age groups than adolescents with weaker motor development.

Discussion

Literature indicates that adolescents with mild mental disorders tend to have low physical fitness (Oppewal et al., 2013; Pitetti & Yarmer, 2002), aligning with the findings of our study. It is found that adolescents with mild mental retardation, environment, and social interactions play a crucial role in influencing physical activity (Stevens et al., 2018).

It is well known that physical activity promotes physical, mental, and intellectual development, but a person's psychophysiological state affects motor ability and the maturity of an adolescent's personality. A connection has been found between reading and motor skills, and trends have been discovered between physical development, mathematics, and attention, which indicates that it is necessary to develop both motor and academic abilities (Westendorp et al., 2011). Children with motor coordination difficulties experience greater psychological distress than their peers (Redondo-Tebar et al., 2021).

Interventions for promoting motor skills at school are necessary to improve children's mental health and quality of life (Gill et al., 2020). In our study, it was observed that the older group of adolescents was better able to concentrate on work and made fewer mistakes in the Vienna tests in comparison with the younger group of adolescents. This suggests that while studying in a special education elementary school, their abilities improve, and their attitude toward work becomes more responsible. Educators likely play a large role in this, and the efforts of educators to involve adolescents with mild mental disorders in physical activities are justified. At the same time, it should be noted that the teenagers, especially in the older group, were rather different, with different intellectual disabilities. In the upbringing of adolescents with mild mental disorders, cooperation between sports teachers, special educators, and physiotherapists is important. Efforts to improve movement coordination skills, various types of exercises, and mental exercises, as well as promoting an active lifestyle, are crucial for adolescents with mild mental disorders.

Riga Special Education Primary School – Development Center pedagogues pay great attention to providing physical activities for adolescents with mild mental disabilities. Adolescents engage in physical activities both during sports classes and in their free time, and their involvement in physical activities is encouraged. The Development Center's sports teachers have extensive experience working with adolescents with mild mental disorders, and educators strive to motivate students to lead an active lifestyle and engage in sports activities.

Conclusions

The results of the study showed that the motor parameters of adolescents with mild mental disorders lag behind the age-specific norm. A characteristic psychophysiological feature of the examined adolescents was the difficulty of concentrating and mobilizing for work. Correlations between individual cognitive and motor developmental indicators were observed. These correlations were more characteristic in the younger group of adolescents with mild mental disorders (11–14-year-old adolescents) than in the older group of adolescents with mild mental disorders (15–16-year-old adolescents). The research showed that the motor and cognitive development of adolescents with mild mental disorders is significantly interrelated.

Physical activities in working with children with mild mental disorders play an important role in the prevention of mental health disorders, as well as in promoting positive mental health.

REFERENCES

Adeniyi, Y. C., Omigbodun, O. O. (2016). Effect of a classroom-based intervention on the social skills of pupils with intellectual disability in Southwest Nigeria. *Child and Adolescent Psychiatry and Mental Health*, 10(1):29. https://capmh.biomedcentral.com/articles/10.1186/s13034-016-0118-3

Belfer, M. L. (2008). Child and adolescent mental disorders: the magnitude of the problem across the globe. *The Journal of Child Psychology and Psychiatry*, 49(3), 226–236. https://doi.org/10.1111/j.1469-7610.2007.01855.x

Bruininks, R. H., Bruininks, B. D. (2005). Bruininks-Oseretsky Test of Motor Proficiency. https://www.pearsonassessments.com

Cech, D. & Martin, S. T. (2012). *Functional Movement Development Across the Life Span*. Third Edition. Elsevier Inc. https://shop.elsevier.com/books/functional-movement-development-across-the-life-span/cech/978-1-4160-4978-4

Farhat, F., Hsairi, I., Baiti, H., Cairney, J., Mchirgui, R., Masmoudi, K., Padulo, J, Triki, C. & Moalla, W. (2015). Assessment of physical fitness and exercise tolerance in children with developmental coordination disorder. Research in Developmental Disabilities, 45–46 (10/11), 210–219. https://pubmed.ncbi.nlm.nih.gov/26263407/

Ghosh, D. & Datta, T. K. (2012). Functional improvement and social participation through sports activity for children with mental retardation: A field study from a developing nation. Prosthetics and Orthotics International, 36 (3), 339–347. https://pubmed.ncbi.nlm.nih.gov/22918912/

Gill. D. L., Williams, L. & Reifsteck, E. J. (2020). *Psychological Dynamics of Sport and Exercise*. Fourth Edition. Human Kinetics. https://www.campusbooks.nz/psychological-dynamics-of-sport-and-exercise-4ed-9781450484664

Horvat, M., Kelly, L. E., Block, M. E. & Croce, R. (2019). *Developmental and Adapted Physical Activity Assessment*. Second edition. Human Kinetics. https://www.academia.edu/110901397/Developmental_and_Adapted_Physical_Activity_Assessment

International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)-WHO (2019). *Mental and behavioural disorders (F00-F99)*. https://icd.who.int/browse10/2019/en#/F70-F79

Keenan, M., Freeman, L., de Lima, E. S., Potter, K., Hobbs, T., Ballard, E. & Fonagy, P. (2025). A systemic approach to identifying sustainable community-based interventions for improving adolescent mental health: a participatory group model building and design protocol. *Health Research Policy and Systems*, 23(9). https://doi.org/10.1186/s12961-024-01247-y

Kieling, C, Baker-Henningham, H., Belfer, M., Conti, G., Ertem, I., Omigbodun, O., Rode, L. A., Srinath, S., Ulker, N. & Rahman, A. (2011). Child and Adolescent mental health worldwide: evidence for action. *The Lancet*, 378(9801), 515–1525. https://doi.org/10.1016/S0140-6736(11)60827-1

Klavina, A., Veliks, V., Zusa, A., Porozovs, J., Aniscenko, A. & Bebrisa-Fedetova, L. (2021). Problematic Internet Use, Related Psychosocial Behaviors, Healthy Lifestyle, and Subjective Health Complaints in Adolescents. *Health Behavior and Policy Review,* 8(5), 451–464 (14). https://dspace.rsu.lv/server/api/core/bitstreams/5b394adf-2065-4bab-bd95-df7b70aa736f/content

Kostecka, M. Bojanowska, M. & Stoma, M. (2017). The role of physical activity in instilling healthy lifestyle habits in children. *Baltic Journal of Health & Physical Activity,* 9(3), 133–140. https://www.balticsportscience.com/cgi/viewcontent.cgi?article=1341&context=journal

Oppewal, A., Hilgenkamp, T. I. M., van Wijck, R. & Evenhuis, H. M. (2013). Cardiorespiratory fitness in individuals with intellectual disabilities – A review. *Research in Developmental Disabilities*, 34(10), 3301–3316. https://pubmed.ncbi.nlm.nih.gov/23892875/

Pelšs, A. (2015). *Statistiskās metodes ekonomikā (Statistical methods in economics).* Rēzekne: Rēzeknes Tehnoloģiju akadēmija. https://dom.lndb.lv/data/obj/file/29069385.pdf

Pitetti, K. H. & Yarmer, D. A. (2002). Lower body strength of children and adolescents with and without mild mental retardation: A comparison. *Adapted Physical Activity Quarterly,* 19(1), 68–81. https://pubmed.ncbi.nlm.nih.gov/28195802/

Podrigalo, O. O., Borisova, O. V., Podrigalo, L. V., Iermakov, S. S., Romanenko, V. V., Podavalenko, O. V., Volodchenko, O. A. & Volodchenko, J. O. (2019). Comparative analysis of the athletes' functional condition in cyclic and situational sports. *Physical Education of Students,* 23(6), 313–319. https://www.researchgate.net/publication/338021852_Comparative_analysis_of_the_athletes'_functional_condition_in_cyclic_and_situational_sports

Redondo-Tebar, A., Ruiz-Hermosa, A., Martinez-Vizcaino, V., Martin-Espinosa, N., Notario Pacheco, B., Sanchez-Lopez, M. (2021). Health-related quality of life in developmental coordination disorder and typically developing children. *Journal Research in developmental disabilities*, 119 (12), 104087. https://www.sciencedirect.com/science/article/pii/S0891422221002365

Stevens, G., Jahoda, A., Matthews, L., Hankey, C., Melville, C., Murray, H. & Mitchell, F. (2018). A theory-informed qualitative exploration of social and environmental determinants of physical activity and dietary choices in adolescents with intellectual disabilities in their final year of school. *Journal of Applied Research in Intellectual Disabilities*, 31, Supplement 1, 52–67. https://pubmed.ncbi.nlm.nih.gov/28401626/

The Vienna Test System. Schuhfried. (2025). https://www.schuhfried.com/vienna-test-system/

Westendorp, M, Hartman, E, Houwen, S, Smith, J. & Visscher, C. (2011). The relationship between gross motor skills and academic achievement in children with learning Disabilities. *Journal of Developmental Disabilities*, 2(6), 2773–2779. https://doi.org/10.1016/j.ridd.2011.05.032