

TRAINING OF GENERAL WORKING PHYSICAL SKILLS OF YOUNG ADULTS WITH INTELLECTUAL DISABILITIES THROUGH AN INTEGRATED PHYSICAL CAPACITY PROGRAM

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Abstract

The article describes a quasi-experiment that lasted 3 months and an integrated physical capacity training (IPCT) program, a diagnostic assessment of general working physical abilities using the Ergos II™ Work Simulator system. The results of the study reveal the impact of the IPCT program on the change of general work physical abilities and the assessment of subjective efforts of young adults with intellectual disabilities.

Keywords: *intellectual disabilities, physical capacity training, general work physical abilities, vocational education.*

Introduction

Like for all members of society, the process of socialization of people with disabilities is inseparable from work activities (Ruškus & Mažeikis, 2007; Baranauskienė & Juodraitis, 2008). Work activity is considered to be the most meaningful form of expression of human life and social participation. Its benefits to the individual include autonomy and financial freedom, increased self-esteem, emotional well-being and improved quality of life (Lemaire & Mallik, 2008; Smith, Grigal, & Sulewski 2013).

According to the documents regulating special education in Lithuania, after the completion of the individualized basic education program since September 1, 2012, students with intellectual disabilities (ID) have been offered to continue their education according to the vocational training program or to develop according to the social skills development program. As a result, vocational training institutions have become the main pathway for young adults with intellectual disabilities (ID) to the labor market. However, very often even with vocational education, people with disabilities face problems in adapting to the labor market, in the process of socialization and at the same time in planning independent life (Ratzon, Schejter, Alon, & Schreuer, 2011; Baranauskienė & Ruškus, 2004). Baranauskienė et al., (2004) point out that the challenges faced by young adults with ID in the transition from the education

system to the labor market and after employment are: “crazy” pace of work; fatigue; health problems; hard physical work; communication problems, etc. The main ones are related to the physical capacity and stress that a person experiences by underperforming or performing, but having difficulty in work-related tasks or specific actions (Ratzon et al., 2011; Gerulaitis & Žukauskaitė, 2013).

It has been observed that the physical development of people with ID becomes a secondary factor in the vocational training process, but it requires much more attention as most individuals find employment in the work requiring physical strength (Ratzon et al. 2011). In young adults, low physical capacity, body muscle weakness, secondary health problems caused by low physical activity negatively affect their occupational and social situation as well as their quality of life (Lotan, Henderson, & Merrick, 2006). This causes difficulties in performing meaningful activities in a work or everyday environment, such as performing a work task. There is an increased risk of fatigue, injuries, work-related illnesses, and occupational disease risk (Shields, Taylor, & Fernhall, 2010).

Physical activity focused on strengthening physical capacity and including the development of motor skills enables young adults with ID to achieve optimal development of the person’s body and health, physical work capacity, resistance to negative environmental factors (Cuesta-Vargas, Solera-Martinez, Ortega, & Martinez-Vizcaino, 2013; Selickaitė, Rėklaitienė, & Požerienė, 2014; Hiesinger & Tophoven, 2019), to form social skills important for a young person’s independent life in society and to actively participate in the labor market. It is observed that there is a wealth of research that demonstrates the health benefits of physical exercise (Frey, et al., 2008), physical capacity, cognitive abilities (Hillman, Kramer, Belopolsky, & Smith, 2006), a mechanism of self-regulation (Selickaitė et al., 2014; Tomaszewski, Fidler, Talapatra, & Riley, 2018), but there is a lack of research to analyze the possibilities of strengthening the physical capacity of young adults with ID in vocational training and preparation for participation in a competitive labor market. Therefore, the problem question is: what effect should an integrated physical capacity training program (IPCT program) have on the general physical work skills of young adults with ID in the vocational training process?

The object of the research: developing the general working physical skills of young adults with ID.

The aim of the research: to assess the impact of an integrated physical skills development program on the general work and physical abilities of young adults with ID.

Methods and organization of the research

The study is conducted according to a quantitative research strategy, choosing a quasi-experimental method (Cohen, Manion, & Morrison, 2000).

The quasi-experiment was conducted in vocational schools where young adults with special educational needs study. The duration of the study was 9 months, of which 3 months were for intervention. This exposure method allows to evaluate the impact of the developed IPCT program on the experimental group. The participants in the experimental group participated in the exercises twice a week for 45 minutes (a total of 24 trainings). There were no effects or constraints or additional conditions on the study participants in the control group. Diagnostic assessment of general working physical abilities is performed at the beginning (pretest) and at the end (post-test) of the experiment. Age, degree of intellectual disability, occupation, comorbidities and/or morbidity, anthropometric height and weight data, arterial blood pressure (mmHg) and heart rate (HR) were important for the initial collection of study data.

Participants of the research

The study involved 40 young people from a vocational school (20 girls and 20 boys) who met the selection criteria. According to the nature of the disability, 30 study participants had a minor intellectual disability and 10 had a moderate intellectual disability. A total of 12 young adults were diagnosed with a complex disorder: activity and attention disorder ($n = 4$), behavioral and emotional disorder ($n = 4$), fluent speech (rhythm) disorder ($n = 2$), and moderate movement and posture disorders ($n = 2$). The average age of the study participants was 20.78 years (boys – 21.7 years, girls – 19.85 years). Homogeneous experimental and control groups were formed according to the characteristics of the study participants.

After the experimental study, the number of participants decreased to 32 participants. Eight study participants refused to participate in the study for various reasons (removal from the list of students, illness, lack of motivation, reluctance to repeat the testing procedure). The agreement provided that a participant in the investigation could, at any time, voluntarily withdraw from the investigation, stating the reasons. There were 18 study participants in the experimental group during the retesting, and 14 study participants in the control group. The data of the 8 subjects who left under the conditions of the experimental study were completely eliminated from the study when comparing and summarizing the results of the study.

Diagnostic assessment of general working physical abilities

To assess the level of general working physical ability, the subjects were introduced to testing and pilot tests (developed by computer programs) were performed on the same day as the testing. The best result from three tests is recorded. The diagnostic assessment is performed in the first half of the day by prior arrangement with the study participants. The same testing conditions are maintained for all study participants.

Ergos II Work Simulator system (version 2011) is used to determine the level of general physical abilities. This diagnostic equipment (see Figure 1) makes it possible to assess a person's real physical abilities rather than their actual ones. Tests are focused on general work criteria and not on individual abilities or psychophysical norms of development. Baseline assessment consists of physical performance of work that is related to physical and functional work factors. Determining the level of general physical ability allows to identify whether the subject meets the necessary physical requirements for a particular job (Waters, Putz-Anderson, & Gargs, 1994; Boadella, Sluiter, & Frins-Dresen 2003).

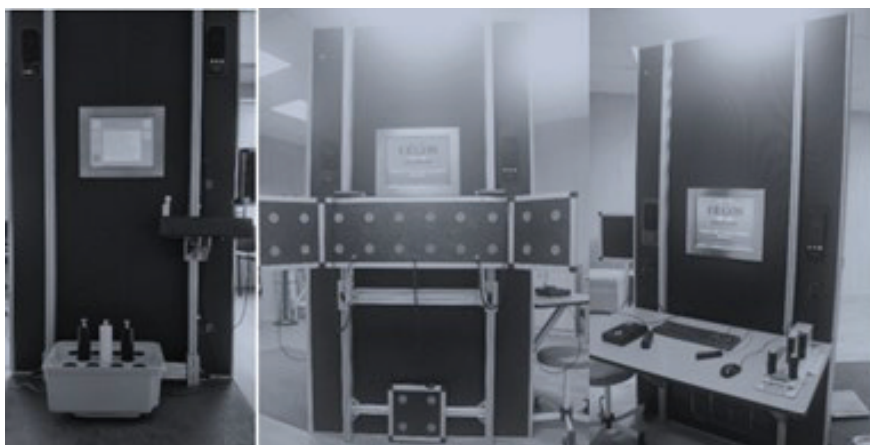


Figure 1. Ergos II Work Simulator system

The program includes a basic set of tests to maintain a level playing field for all study participants. The basic set consisted of 11 tests: static and dynamic strength evaluation (4 tests, each of them are performed in different positions: cart, bench, shoulder and ankle height), general body motion range evaluation (2 tests – reaching forward height and standing bending), upper extremity strength and handling dexterity evaluation (5 tests).

Following the testing procedure, each study participant performed the Borg (1982) test. This test is designed to subjectively evaluate the effort put in during testing. The test provides a 20-point scale in which the subject must rate the effort on a scale of 6 to 20.

Integrated Physical Capacity Program (IPCT)

The IPCT program is based on dynamic, ecological theory of movement teaching. Dynamic, ecological theory of movement teaching is considered productive in solving individuals’ motor problems and inaccuracies (Gibson & Pick 2010; Skurvydas, 2017). According to this theory, the goal of the IPCT program is to promote motor literacy, which is related to the development of motor skills. The IPCT program includes the development of physical abilities (applied resistance exercises), the promotion of cognitive functions (dual task integration) and the development of psychomotor functions (training of body movement response speed). A dual-task method is when a person performs a primary task or action (such as standing on one leg while maintaining balance) while performing an additional task that can be cognitive (such as counting) or motor (such as throwing a ball to the wall and catching it) (Holmes, Jenkins, Johnson, Adams, & Spaulding, 2010).

Exercise duration – 45 minutes: dynamic warm-up (5 min), main part (35 min), final (5 min). Physical exercises are performed on a circular basis. During one session 6-7 “stops” are prepared, in which the appropriate means for performing the physical exercise are prepared, the performance of the exercise is visually presented and the number of repetitions is marked. A young person performs physical exercises, one series, at each “stop”, after completing all the circle exercises, a 2 minute break is taken. After the break, the circle exercises are repeated (default sequence). The exercises are performed in 3 series (i.e., the lap exercises are repeated three times, with a rest of 2 minutes between each lap repetition).





Evaluation tasks	Physical exercises
 <p data-bbox="544 1570 713 1590">Dynamic lifting</p>	 <p data-bbox="754 1570 1149 1590">Weighted box lifting (bench height 91,5 cm)</p>
 <p data-bbox="544 1821 713 1836">Reaching forward</p>	 <p data-bbox="738 1787 1161 1807">Planking with arms in front and touching lights</p>

Figure 2. Example of physical exercises, applied in the IPCT program and their link with evaluation tasks

The number of repetitions of an exercise depends on the complexity of the exercise used for the resistance. Rest between stops is for up to 15 seconds. The main part of the workout aims to maintain moderate physical intensity (60-70% of the maximum heart rate). Exercise intensity is calculated individually according to the method of Karvonen & Vuorimaa (1988).

Statistical analysis was performed using SPSS 20.0.0 for Windows software package. Applying the *Shapiro and Wilk* test, it was found that the data distributions are abnormal and non-parametric methods of analysis are chosen. The *Wilcoxon Z* criterion was used to determine the differences in the variables between the two dependent samples. The Cohen *d* criterion was calculated to estimate the magnitude of the effect. Cohen *d* – effect size, coefficients: low effect – 0.1-0.3; average effect – 0.3-0.5; high (strong) exposure > 0.5. The Spearman correlation coefficient was used to determine the correlation between the variables. Differences in results were considered statistically significant if the error probability value was $p < 0.05$ with a 95% confidence interval. (Cohen et al., 2000; Pukėnas, 2005).

Research results

In order to reveal the IPCT program, the results of the study on the effect on the experimental group are analyzed in terms of the change in the groups using the Wilcoxon *Z* criterion and the effect size Cohen *d* (effect size) is calculated. Data are considered statistically significant at $p < 0.05$. The analysis of the data takes into account the results of the static maximum force (kg) and the coefficients of variation (CoVar) calculated during the test procedure. The coefficient of variation, expressed as a percentage, indicates the stability of the force performed during testing, the lower the percentage, the better the stability of the force (Pukėnas, 2005).

Table 1. Comparison of the results of the maximum force of the static lifting (kg) and the coefficients of force variation in the experimental and control groups

Variables	Experimental group (n=18)				Control group (n=14)			
	Pretest	Post-test	Z	p	Pretest	Post-test	Z	p
	M	M			M	M		
Bench height (kg)	22,97	26,37	-3,33	0,0009	20,77	22,91	-1,79	0,07
Co Var (%)	4,31	4,91	-0,07	0,94	5,78	6,97	-1,43	0,15
Ankle height (kg)	25,68	28,16	-1,55	0,12	20,89	25,16	-1,16	0,25
Co Var (%)	3,38	3,42	-1,63	0,1	5,56	5,92	-1,54	0,12
Shoulder height (kg)	22,87	35,9	-3,16	0,002	21,33	24,75	-2,79	0,01
Co Var (%)	4,29	3,66	-3,33	0,001	5,24	6,16	-2,73	0,01

Note: M – median, Co Var – covariation coefficient (%)

A statistically significant difference was found between the results of the maximum static lifting force of the experimental group of young people at the height of the bench ($z = -3.33$, $p = 0.0009$, $r = 0.79$) and shoulders ($Z = -3.16$, $p = 0.002$, $r = -0.56$) before and after the experiment (Table 1). The maximum force of static lifting at the table and shoulder height and the stability of the static lifting force ($Z = -3.33$, $p = 0.001$, $r = -0.59$) at shoulder height increased significantly. In the control group, a statistically significant difference was found between the results of the static lifting maximum force at shoulder height ($Z = -2.79$, $p = 0.01$,

$r = -0.49$) and the coefficients of variation of force ($Z = -2.73$, $p = 0.01$, $r = -0.48$) before and after the study. In summary, the applied physical performance training program had a positive effect on the change of the results of the maximum static force at the bench height (Cohen $d = 0.87$) and the force stability during static lifting at shoulder height (Cohen $d = 0.63$). A moderate positive effect was found on the changes in the maximum static lifting force at the ankle (Cohen $d = 0.43$) and shoulder (Cohen $d = 0.38$) height.

Table 2. Comparison of the results of the maximum force (kg) and force variation coefficients of the static pushing and pulling in the experimental and control groups

Variables	Experimental group (n=18)				Control group (n=14)			
	Pretest	Post-test	Z	p	Pretest	Post-test	Z	p
	M	M			M	M		
Static pushing cart height (kg)	22,63	26,88	-2,11	0,03	21,17	22,36	-0,03	0,97
Co Var (%)	2,45	2,68	-0,16	0,88	3,18	3,82	-2,51	0,01
Static pushing shoulder height (kg)	20,05	20,53	-0,07	0,95	18,51	19,02	-0,22	0,83
Co Var (%)	2,75	2,6	-0,41	0,68	4,17	3,31	-0,71	0,48
Static pulling cart height (kg)	18,9	21,38	-2,44	0,01	17,35	19,12	-0,91	0,36
Co Var (%)	3,06	3,99	-0,85	0,15	4,06	4,98	-0,31	0,75
Static pulling shoulder height (kg)	14,53	19,75	-3,64	0,0001	15,06	15,42	-1,1	0,27
Co Var (%)	2,64	2,66	-0,59	0,55	6,13	4,86	-0,86	0,39

Note: M – median, Co Var – covariation coefficient (%)

When evaluating the maximal force results of the upper extremities, statistically significant differences were found in the experimental group between the results of all evaluated variables ($p < 0.01$): hand grip (left hand ($Z = -3.16$, $p = 0.002$, $r = 0.74$) and right hand ($Z = -3.46$, $p = 0.001$, $r = 0.82$)), forearm pronation (left hand ($Z = -2.86$, $p = 0.004$, $r = 0.68$) and right hand ($Z = -3.15$, $p = 0.002$, $r = 0.74$)) and supination (left hand ($Z = -3.48$, $p = 0.001$, $r = 0.82$) and right hand ($Z = -3.53$, $p = 0.0004$, $r = 0.83$)), wrist bending (left hand ($Z = -2.84$, $p = 0.005$, $r = 0.67$) and right hand ($Z = -2.84$, $p = 0.005$, $r = 0.67$)) and construction (left hand ($Z = -3.34$, $p = 0.001$, $r = 0.79$) and right hand ($Z = -3.15$, $p = 0.002$, $r = 0.74$)) maximum force results before and after the study. No statistically significant differences were found between the maximal force results of the upper extremities in the control group before and after the study ($p > 0.05$)

The IPCT program had a strong positive effect on the maximal force of the left (Cohen $d = 0.64$) and right (Cohen $d = 0.87$) forearms of the experimental group during pronation and on the maximum force of the left (Cohen $d = 0.82$) forearm during supination. The IPCT program had a moderate effect on the maximum grip force of the left (Cohen $d = 0.38$) and right (Cohen $d = 0.41$) hands of the experimental group. The program had a positive weak and moderate effect on the bending of the wrists of the experimental group (left hand – Cohen $d = 0.28$, right hand – Cohen $D = 0.32$) and wrist extension (left hand – Cohen $d = 0.17$, right hand – Cohen $d = 0.18$) for the change in maximum force results.

Table 3. Speed of total body range of motion in response to stimulus and comparison of handling dexterity results (MTM) in experimental and control groups

Variables	Experimental group (n=18)				Control group (n=14)			
	Pretest	Post-test	Z	p	Pretest	Post-test	Z	p
	M	M			M	M		
Reaching Forward height	143,03	159,23	-3,1	0,002	145,2	135,95	-0,94	0,35
Standing Bending	107	108,55	-0,22	0,83	98,65	102,6	-0,25	0,81
Handling Dexterity, Left hand	73,55	79,8	-2,741	0,01	62,55	64,9	-1,92	0,05
Handling Dexterity, Right hand	72,6	84,55	-2,669	0,01	68,35	72,1	-0,11	0,92

Note: M – median, Co Var – covariation coefficient (%)

The assessment of total body movement range and handling dexterity is made by calculating MTM (*Methods Time Measurements*), which analyzes physical work, any manual work and the basic human movements needed to do the job effectively. Each movement is assigned a pre-defined MTM standard, which is determined by the nature of the movement and the environmental conditions. MTM standard ranges: 0-70 percent – below competitive; 71-80 percent – entry level; 81-100 percent – competitive; over 100 percent – above competitive (Boadella, Sluiter, & Frins-Dresen, 2003).

A statistically significant difference was found in the experimental group between advancing forward ($Z = -3.10$, $p = 0.002$, $r = 0.73$), left handling dexterity ($Z = -2.741$, $p = 0.01$, $r = 0.65$) and right handling ($Z = -2.669$, $p = 0.01$, $r = 0.63$) dexterity results before and after the study (Table 3). Calculating the magnitude of the effect, it was found that the IPCT program had a very strong effect on the experimental group's reaching forward (Cohen $d = 1.8$), left (Cohen $d = 0.69$), and right (Cohen $d = 1.33$) handling dexterity MTM results. In the control group, a statistically significant difference was found between the results of left handling dexterity ($Z = -1.92$, $p = 0.05$, $r = 0.45$) before and after the study. The magnitude of change was moderate (Cohen $d = 0.34$). There was no statistically significant difference ($p > 0.05$) between the results of the other variables evaluated.

After analyzing the results of subjective effort evaluation of the study participants before and after the study using the *Wilcoxon Z* criterion, a statistically significant difference was found in the experimental group between subjective effort results before and after the study ($Z = -2.83$, $p = 0.005$, $r = 0.67$). It was found that there was a statistically significant decrease in the evaluation of the subjective efforts of the experimental group study participants (a decrease of 1.5 points) experienced during testing, after the study. No statistically significant differences were found in the control group ($p > 0.05$).

Discussion

The IPCT program was found to have a moderate effect (Cohen $d > 0.3$) on static body strength, it had a strong effect (Cohen $d > 0.5$) on a static lift at desktop height; the speed of body movements forwards; hand dexterity; maximal strength results of the upper extremities (compression, pronation and supination) and subjective assessment of the feeling of fatigue (Cohen $d > 0.5$). There has been a reduction in fatigue during physical performance assessment. The obtained results confirm that with the increase of physical work capacity the psychological

feeling of fatigue decreases (Cuesta-Vargas et al., 2013), the speed of work movements and the speed of reaction improve (Hillman et al., 2006; Selickaitė et al., 2014). Positive (moderate $r > 0.3$ and strong $r > 0.5$) correlations were found between the static force variables and the speed of body movements in response to the stimulus and between the speed of movement, hand dexterity in response to the stimulus, and inhibition control. These calculations confirm that the speed of body movements and the dexterity of the hands in response to the stimulus depend on the static strength and endurance of the body muscles.

Comparing the strength levels of the experimental and control groups by the categories of work requiring physical strength, it was found that the applied IPCT program had a positive effect on the change in the strength levels of young people corresponding to the categories of work. The level of competitiveness of body movement speed and hand dexterity in the experimental group increased – 10.85 %, the level of body muscle strength by work categories increased on average by 12.18 %. As expected, no statistically significant differences ($p > 0.05$) were found between the strength levels corresponding to the work categories in the control group, although the maximum strength indicators varied, however, the total calculated physical fitness level changed insignificantly. Analyzing the correspondence of physical abilities according to the categories of labor-intensive work and comparing with previous studies (Gerulaitis et al., 2013; Mockevičienė & Dobrovolskytė, 2013) involving subjects of similar age and characteristics, we notice that better results were achieved during our experiment than with physical work programs alone (this has been done in previous studies). For example, changes in body movement speed and hand dexterity are observed in a larger number of study participants (in our study, a competitive level of work according to the MTM standard was achieved in an average of 9 out of 18 study participants (half of the study participants) and Mockevičienė et al., (2013) achieved a competitive level of work according to the MTM standard in an average of 5.25 out of 25 study participants).

In summary, an integrated holistic approach to physical capacity building is important for the development of physical capacity. Properly selected physical resistance exercises that activate cognitive and develop psychomotor functions have a positive effect on the physical performance of young adults with ID (Carmeli, Marak, Borad, & Kodesh, 2009). The interaction of all these components can have a major impact on a young person's success in academic achievement, success at work, public safety, and maintaining health.

Conclusions

The IPCT program had a statistically significant effect ($p < 0.05$) on the changes in the maximum strength and strength stability of static body muscles.

The level of static strength of body muscles by work categories increased on average by 12.18%, the level of competitiveness of body movement speed and hand dexterity in the experimental group increased by 10.85%.

The IPCT program was found to have a moderate effect (Cohen $d > 0.3$) on the maximum static force during ankle and shoulder lifting, cart pushing, cart and shoulder lifting; had a strong (Cohen $d > 0.5$) effect on the maximum static force during lifting at the height of the bench, the results of the maximum force of hand grip, forearm pronation and supination, wrist flexion and extension; a very strong effect (Cohen $d > 1$) on the speed of body movements towards the front and on the dexterity of the hand; a strong (Cohen $d > 0.5$) effect on reduction of effort and fatigue.

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TRAINING OF GENERAL WORKING PHYSICAL SKILLS OF YOUNG ADULTS WITH INTELLECTUAL DISABILITIES THROUGH AN INTEGRATED PHYSICAL CAPACITY TRAINING PROGRAM

Summary

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According to the documents regulating special education in Lithuania, after the completion of the individualized basic education program since September 1, 2012, students with intellectual disabilities (ID) have been offered to continue their education according to the vocational training program or to develop according to the social skills development program. As a result, vocational training institutions have become the main pathway for young adults with intellectual disabilities (ID) to the labor market. However, very often even with vocational education, people with disabilities face problems in adapting to the labor market, in the process of socialization and at the same time in planning independent life

(Ratzon et al., 2011; Baranauskienė et al., 2004). It has been observed that *the physical development* of people with ID becomes a secondary factor in the vocational training process, but it requires much more attention as most individuals find employment in the work requiring physical strength (Ratzon et al. 2011). In young adults, low physical capacity, body muscle weakness, secondary health problems caused by low physical activity negatively affect their occupational and social situation as well as their quality of life (Lotan et al., 2006).

Many scientific articles demonstrate the health benefits of physical exercise (Frey et al., 2008), physical capacity, cognitive abilities (Hillman et al., 2006), a mechanism of self-control (Selickaitė et al., 2014; Tomaszewski et al., 2018), but there is a lack of research to analyze the possibilities of strengthening the physical capacity of young adults with ID in vocational training and preparation for participation in a competitive labor market. Therefore, the problem question is: what effect should an integrated physical capacity training program (IPCT program) have on the general physical work skills of young adults with ID in the vocational training process?

The object of the research – developing the general working physical skills of young adults with ID. *The research aim* – to assess the impact of an integrated physical skills development program on the general work and physical abilities of young adults with ID.

The IPCT program was found to have a moderate effect (Cohen $d > 0.3$) on static body strength, it had a strong effect (Cohen $d > 0.5$) on a static lift at desktop height; the speed of body movements forwards; hand dexterity; maximal strength results of the upper extremities (compression, pronation and supination) and subjective assessment of the feeling of fatigue (Cohen $d > 0.5$). There has been a reduction in fatigue during physical performance assessment.

In summary, the IPCT program had a statistically significant effect ($p < 0.05$) on the changes in the maximum strength and strength stability of static body muscles, decrease of the subjective efforts. The level of static strength of body muscles by work categories increased on average by 12.18%, the level of competitiveness of body movement speed and hand dexterity in the experimental group increased by 10.85%. The interaction between physical resistance exercise, psychomotor functions and cognitive function stimulation can have a major impact on a young person's success in academic achievement, success at work and maintaining psychosocial health.

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