

# Effects of adapted karate program in the treatment of persons with mild intellectual disability

## Authors' Contribution:

- A** Study Design
- B** Data Collection
- C** Statistical Analysis
- D** Manuscript Preparation
- E** Funds Collection

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## Abstract

### Background and Study Aim:

Adapted sports activities play a significant role in working with persons with developmental difficulties. This study deals with the effects of such a program, where elements of karate have been applied. Aim of analysis there are the changes (assuming that the stimuli will be strong enough) in motor and psycho-social traits created under the influence of adapted karate.

### Material and Methods:

A 12-week long experimental treatment (3 trainings per week lasting for 60 minutes in inclusive conditions) has been applied to the sample of 15 adolescents (8 male, 7 female) with mild intellectual disability, ages of 16-19 years old. Before and after the treatment the developmental level of psycho-physical characteristics of the examinees had been evaluated. A standardized scale of adaptive behavior was used to evaluate the general physical development, self-initiative, perseverance and the level of social interaction. The quality of specific motoric skills was evaluated by a numeric scale during the performance of karate elements.

### Results:

The adapted karate program had a positive impact on the psycho-physical development of the examinees. A statistically significant progress of physical development, social interaction and specific motor skills has been recorded. Significant changes have not been determined only for self-initiative and perseverance. The gender of the examinees did not have a statistically significant impact in regards to any of the changes occurring during the experimental period.

### Conclusions:

The study results proved the importance of systematic physical activity for improving motor development and psycho-social status of persons with mild intellectual disability. It is not sufficiently explained to what extent the work in inclusive conditions contributed to the change of adaptive behavior, which is the reason for a new research with the control group.

### Keywords:

adaptive behavior • motor skills development • perseverance • psycho-social development • self-initiative • social interaction

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Authors have declared that no competing interest exists

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**Intellectual disability (ID) –**

it is a condition characterized by constraints on cognitive and adaptive functions: thinking, speech, motoring, and the ability to achieve social contact [47]. ID occurs before the age of eighteen and requires active support of the society [48]. Decreased intelligence (IQ) and deficit of adaptive functioning are the basic criteria for ID classification [49]. There are 4 levels of ID: mild, moderate, severe and heavy.

**Mild intellectual disability (MID) –**

persons with Mild intellectual disability (MID) have IQ between 50 and 70% and correspond to a mental age of 9 to 12 years. They pass the phase of cognitive development slowly, retain on the level of concrete operations in thinking, and do not reach the level of abstract thinking. Although with difficulties, persons with MID can be educated and learn the basic academic skills – reading, writing, basic arithmetic operations [1].

**Adaptive skills –** the ability to perform daily activities of which the human personal and social life depends. They include responsibility for individual needs and response to the needs of others [50]. Adaptive skills are created, existed and realized through the interaction of personality and environment. The researchers observed them through individual capacities for successful adaptation and directed development [51].

**Adapted sport (karate) –**

adapted sport is specific physical activity in line with the possibilities of the persons with specific psycho-dynamic and motor functions [52] (Winnick, 2011). Adapted sport has a broader meaning than Disability sport because it indicates not only the possibility of competition, but also the permanent improvement of the quality of life for people with disabilities. Martial arts (particularly adapted karate) are very suitable for the daily physical activity of persons with disabilities [53].

## INTRODUCTION

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Over a billion people in the world live with some form of disability, and almost 200 million are faced with significant difficulties in functioning. According to the WHO poll [1], around 785 million (15.6%) of persons over the age of 15 live with disability, and globally this amounts to around 975 million (19.4%) persons burdened with such illnesses. In the Republic of Serbia, around 3% of the total population consists of persons with difficulties in intellectual development, and 7% with physical disability [2]. Persons with physical disability have a weaker health status, lower education, show less economic participation, have a lower rate of employment and higher poverty rate than the persons without physical disability. These difficulties are more pronounced in smaller and less developed communities [3].

Not all persons with physical disability are in equally unfavorable position. Children with physical injuries are „at better odds“ than their peers with intellectual or sensory disability [4]. Persons with worse mental health or intellectual disabilities are those most excluded from everyday life, and particularly from the job market. This is supported by the data from most societies, from the urban European [5] to the rural areas of Guatemala [6]. Persons with intellectual difficulties must be helped as early as possible, and thus ensure an easier conquering of societal barriers. This study deals with adolescents with intellectual difficulties that have been included in a specific sport program focused on improving motor and adaptive skills. The research idea was based on the results of previous empirical studies that indicate positive effects of very diverse adapted programs. Most studies deal with the analysis of the general effects of regular physical activity, and its significant positive impact on the condition of persons with intellectual disability has been proven [7-15]. These studies have combined various movements (shaping exercises, corrective gymnastics, walking, running, ball games, etc.), without particularly focusing on any specific sport. Significantly fewer research studies have dealt with specific impact of individual adapted sports. Some studies have registered positive effects of adapted basketball [16-18], football [19, 20], swimming and water activities [21, 22], table tennis [23] or adapted fitness [24, 25]. Some studies have analyzed separate impact of individual motor abilities on the development of persons with intellectual disability, for example, coordination

[26, 27], muscle strength [28], balance [28, 29], but also motor skills in general [30].

Among the adapted activities that had a positive impact on the life quality of persons with intellectual disability are also combat sports [31-35]. These experiments combined elements of various combat sports (primarily boxing, judo and wrestling, and karate to a lesser degree). The data regarding independent application of adapted karate are few. One of the rare studies indicates a positive impact of karate on decreasing stereotypical behavior in children with autism [36]. In Germany, karate is experimentally applied as therapy for persons with disability [37]. A typical example is the accredited program of the Bavarian Karate Federation, which is being applied as a therapeutic discipline in cooperation with the Disability and Rehabilitation Sports Federation since 2009. The basic trumps upon which the idea regarding the application of adapted karate in persons with intellectual disability has been founded on are: diversity of motor movements in karate, the use of a large number of neuro-musculature synapses, didactic-methodic suitability, and undemanding material and spatial conditions for training.

Aim of analysis there are the changes (assuming that the stimuli will be strong enough) in motor and psycho-social traits created under the influence of adapted karate.

## MATERIAL AND METHODS

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**The sample**

The sample consisted of 15 examinees (8 male) with mild intellectual disability (MID) and it was homogenized in relation to that criterion, all ages from 16-19 years old. The results of the most previous studies have indicated that there are no significant differences in the response to training stimuli of adapted sports amongst the persons with MID of various age [17, 18, 23, 33, 35, 36], and for this reason, despite the age difference of 3 years between the oldest and the youngest examinee, the sample was treated as a whole. The evaluation of the development of motor skills level and social adaptation was done by experts from Special school „May 9<sup>th</sup>“ from Zrenjanin, attended by the examinees included in the sample.

**Study design**

The research was realized as a single group experiment and it had lasted for 12 weeks. The

data were gathered before the beginning of the experimental treatment (pre-test) and following the completion of the program (post-test). During the experimental period, the examinees had exercised regularly two times per week. Before the experiment, the parents (and legal guardians) of the examinees were introduced with the program and the manner of obtaining data. It was recommended for the examinees to continue with their usual daily regime during the experimental period. Consent was acquired from all parents and legal guardians for the participation of the examinees in the experiment.

The study was performed in accordance with the Declaration of Helsinki. Apart from the program of adapted karate, the examinees did not have any additional systemic exercise during the experiment. The effects of the program were valorized by data comparison of the pre-test and the post-test regarding the general development of motor skills, social adaptation, and the level of adoption of karate elements.

### Variables and measurement

During the research, 7 dependent variables were observed (3 from adaptive behavior area and 4 from specific motor skills). For the evaluation of the variables of adaptive behavior, 3 out of 24 subscales in total of the complex instrument named ABS (Adaptive Behavior Scale) were used, which was developed by the American Association on Mental Deficiency (AAMD) and it was recommended to be used for describing and evaluating physical and psycho-social abilities of people with mental disabilities, those with problems with emotional adaptation, and persons with developmental difficulties. These 24 subscales are divided into two groups, the first one relates to 10 characteristics of personal independence, and the second to 14 characteristics of maladapted behavior [38]. In several empirical studies, high reliability and factorial validity of ABS have been confirmed [39-42]. Three subscales of AAMD questionnaire applied in our research belong to the first group of characteristics (personal independence) and they serve to evaluate the variables that could potentially be influenced by the experimental treatment: **physical development** (2nd subscale of AAMD questionnaire, part-b, items: 24, 25, 26 and 27); **self initiative and perseverance** (8th subscale, items: 53, 54, 55 and 56), and **social interaction** (10th subscale, items: 24, 25, 26 and 27).

The variables of specific motor skills were quantified through a five point Lykert-type scale, on which individual numerical levels have the following meaning: 0 – the examinee observes the task but is not attempting to perform it; 1 – the examinee is attempting but is not successful in the performance of the task; 3 – the examinee is performing the task but is not in the condition to coordinate and link more than six consecutive successful performances; and 4 – the examinee coordinates and performs the complete task (links the performance of the complete series consisting of 10 repetitions).

The scaling has always been done by the same three coaches while observing the examinee performing the given karate element or a combination of elements. Prior to the scaling, the coach has demonstrated the task to be performed to the examinees. Motor skills tasks (14 exercises in total) used to evaluate the level of the karate technique were divided into 4 hierarchal levels in the following manner: 1) performance of only one element in place (elements used: *zenkutsu dachi*, *heiko dachi*, *kizami zuki*, *giako zuki*, *mae geri*, *age uke*, *ude uke* and *gedan barai*); 2) combinations of two linked elements in place (combinations used: double *choko zuki* and *choko zuki* with rotation); 3) performance of one element in motion (*oi zuki* and *kizami zuki*); and 4) combinations of two elements in motion (*ren zuki* and *mae geri – kizami zuki*). For statistical analysis only 4 group variables were used: Simple karate elements, karate combination, Simple elements in motion, and combined elements in motion. Mean was calculated as their representative numerical data (extracted from suitable simple items).

### Data analysis

The descriptive indicators (mean and standard deviation) were calculated for all variables. To test the significance of differences between male and female on the pre-test and the post-test, i.e. to analyze the effects of the experimental treatment, Analysis of variance with repeated measures that combined two subjects was used: the experimental treatment and the gender specificity of groups. This statistical procedure is called mixed between-within subjects ANOVA by Tabacnick [43] and Pallant [44]. Portable IBM SPSS v.19 application was used for the analysis, and all the conclusions were drawn based on 0.05 level of significance ( $p \leq 0.05$ ).

**A Likert scale** – is a psychometric scale commonly involved in research that employs questionnaires. It is the most widely used approach to scaling responses in survey research, such that the term (or more accurately the **Likert-type scale**) is often used interchangeably with **rating scale**, even though the two are not synonymous [54].

## Experimental treatment

The experimental program lasted for 12 weeks. The examinees exercised regularly two times a week in the facilities of the “Zrenjanin” Karate Club in controlled environment. On average, 8 to 10 training sessions were realized per month. Each training session lasted for about 60 minutes and it had a standard, pre-planned structure (5-7 minutes of warm-up, 5-6 minutes of shaping exercises, 25-30 minutes of learning and practicing karate elements, and 10-15 minutes of strength and stretching exercises). During one training session, the examinees learned the maximum of two new elements, while more time was dedicated to reviewing previous content. During the first month, the examinees exercised as an independent group, while during the second and the third month at least one training session was organized in inclusive conditions (the examinees trained together with several experienced exercisers from the “not disabled” population). The trainings were headed by two highly trained coaches with experience in working with persons with developmental difficulties. During the inclusive trainings, the exercisers from the “not disabled” population aided the examinees (explained the tasks and corrected the mistakes).

The karate elements were performed in controlled sessions. The number of repetitions in a single series was most frequently ten. Prior to exercising, the coaches had demonstrated each task in a slower tempo and provided short explanations. In the communication with the examinees the coaches attempted to install trust, to be accessible, and at the same time sufficiently authoritative. During the training sessions, some didactic tools were used as well, predominantly the elements

of direct reality (drawings, photographs, video). During the training, it was demanded of the examinees to assume the posture in which the position of the pelvis is higher compared with standard execution. All the exercises in motion were realized exclusively in a straight line. After each series, the examinees were given feedback, and when possible, the coach explained the practical application of the technique with the use of safe tools. Occasionally, the examinees had the opportunity to independently perform the given exercise before their group.

## RESULTS

The results prove that a 12-week systematic exercise can efficiently influence the improvement of specific motor skills of adolescents with MID, and that both males and females can exercise in the training sessions at the same time.

The relation of the pre-test and the post-test results indicates that during the experimental period statistically significant positive changes have occurred in 6 of the 7 variables in total. Significant changes have not been recorded only for **social interaction**. The data gathered by applying AAMD scale indicate the statically significant higher values of the post-test for **physical development** and **self initiative and perseverance** (Table 1). Mixid ANOVA statistics indicates that only the experimental treatment had a significant effect on these changes, while the impact of sex has not been proven (Table 2).

All 4 post-test means gained for the specific (karate) motor skills (simple karate elements,

**Tabela 1.** Descriptives for variables of adaptive behavior.

Variable	Gender	N	Pre-test		Post-test	
			Mean	SD	Mean	SD
Physical development	Male	8	11.00	1.195	12.38	1.685
	Female	7	10.71	1.380	11.57	.976
	Total	15	10.87	1.246	12.00	1.414
Self initiative and perseverance	Male	8	7.38	1.768	7.63	1.768
	Female	7	6.71	1.890	6.57	1.718
	Total	15	7.07	1.792	7.13	1.767
Social interaction	Male	8	13.88	2.850	14.75	2.493
	Female	7	13.43	2.878	14.00	2.646
	Total	15	13.67	2.769	14.40	2.501

**Tabela 2.** ANOVA Statistics for variables of adaptive behavior.

Variable	Wilks' Lambda	F	Sig.	Partial Eta Squared
<b>Physical development</b>				
Treatment^Gender impact	.915	1.213	.291	.085
Treatment impact	.366	22.532	.000	.634*
Gender difference		.691	.421	.050
<b>Self initiative and perseverance</b>				
Treatment^Gender impact	.883	1.719	.212	.117
Treatment impact	.990	.128	.726	.010
Gender difference		.884	.364	.064
<b>Social interaction</b>				
Treatment^Gender impact	.930	.975	.342	.070
Treatment impact	.370	22.125	.000	.630*
Gender difference		.183	.676	.014

\*Statistical significant.

**Tabela 3.** Descriptives for specific karate skills

Variable	Gender	N	Pre-test		Post-test	
			Mean	SD	Mean	SD
Simple karate elements	Male	8	2.94	.513	3.50	.384
	Female	7	2.41	.967	3.23	.659
	Total	15	2.69	.779	3.38	.528
Karate combination	Male	8	3.00	.655	3.38	.582
	Female	7	2.21	.756	2.93	.932
	Total	15	2.63	.790	3.17	.771
Simple elements in motion	Male	8	2.56	.678	3.44	.417
	Female	7	2.07	1.018	3.14	.748
	Total	15	2.33	.859	3.30	.592
Combined elements in motion	Male	8	2.13	.518	3.00	.535
	Female	7	1.79	.809	2.57	.838
	Total	15	1.97	.667	2.80	.702

combined karate elements, karate techniques in motion and combined elements in motion) had statistically significant higher valued from the pre-test (Table 3). As with AAMD variables, only the experimental treatment had a significant impact on explaining these changes, while the impact of gender was not significant (Table 4).

## DISCUSSION

The methodological presumption of experimental studies is that that they are realized according to Randomized Controlled Trial (RCT) model.

While treating persons with mild intellectual disability (MID), it is very difficult (frequently impossible) to ensure a sufficiently large basic set from which to form a randomized sample by using accidental selection. It is even more difficult to extract a control group with the same characteristics as the experimental group from the small number of potential examinees. The formation of a control group from the "non-disabled" population in this case was pointless. A small number of examinees, the lack of randomization, and the lack of control group are the main limitations of this study and lower the possibility of generalizing the gained results. While selecting the examinees, the degree

**Tabela 4.** Mixid ANOVA statistics for simple elements of standing karate techniques

Variable	Wilks' Lambda	F	Sig.	Partial Eta Squared
<b>Simple karate elements</b>				
Treatment^Gender impact	.829	2.680	.126	.171
Treatment impact	.145	76.550	.000	.855*
Gender difference		1.461	.248	.101
<b>Combined karate elements</b>				
Treatment^Gender impact	.808	3.098	.102	.192
Treatment impact	.289	31.929	.000	<b>.711*</b>
Gender difference		2.809	.118	.178
<b>Karate techniques in motion</b>				
Treatment^Gender impact	.947	.723	.410	.053
Treatment impact	.155	71.013	.000	<b>.845*</b>
Gender difference		1.178	.297	.083
<b>Combined elements in motion</b>				
Treatment^Gender impact	.978	.297	.595	.022
Treatment impact	.112	102.682	.000	.888*
Gender difference	1.259	.282	.088	1.259

\*Statistical significant

and the type of intellectual disability as the basic criteria for homogenization was the primary concern. Such a selection of the examinees characterizes the sample as a group (cohort), and defines the study as a quasi-experiment.

Another potential methodological obstacle for a valid conclusion was the sample contents related to sex. The results gained, however, have confirmed the conclusions from previous studies that adapted sports activity programs can be applied freely to persons with MID of different gender [17, 18, 23, 33, 35, 36]. This finding confirms the high applicability of the frontal method for practicing karate. None of the 21 variables resulted in a statistically significant influence of sex on the differences between the average values of male and female, both on the pre-test and the post-test. These data confirm the validity of the initial homogenization of the sample and prove that the psycho-social and motor features of the complete sample (general motor skills, **self-initiative and perseverance**, **social interaction** and specific motor skills) were on approximately the same level. In this way, a good methodological basis was created for a more reliable evaluation of the effects of the experimental program.

The comparison of the results gained from the pre-test and the post-test indicates that, during the experimental period, significant positive changes have occurred in most variables. Significant changes have not been proven for only two variables: **self-initiative and perseverance**, and **heiko dachi** (specific motor skills). The results of the combined variance analysis indicate that the changes were primarily influenced by the experimental treatment, while the impact of sex was not significant. These results prove that a 12-week karate training can be used to efficiently improve general and specific motor skills of adolescents with MID, as well as to increase the level of **social interaction**. These findings are in accordance with the results of previous studies dealing with the positive effect of physical activities on the condition of persons with MID, both the exercises of the general type [14, 15], and the specific adapted programs, for example, basketball [17, 18], or swimming and water activities [21, 22].

By comparing the scalar averages gained in the initial and the final application of the AAMD scale of adaptive behavior it was determined that significant changes were lacking only with the self-initiative and perseverance variables, which can be explained by the inadequate content of the

applied stimuli. During the entire experimental period, the examinees were carefully guided through the training stimuli and faced only with the pre-programmed demands. The need to show self-initiative was additionally lowered by working in inclusive conditions, where exercisers with “non-disabled” intellectual abilities aided the trainers and the examinees in great measure to successfully solve the posed tasks. If this hypothesis is correct, it can be concluded that working in inclusive conditions contributes to a speedier progress of **social interaction**, general and specific motor skills, but probably decreases the need of the examinees to demonstrate self-initiative and develop perseverance.

The previous dilemma opens the door to inclusion analysis, the application of which is advocated by a large number of experts in the previous years. Inclusive education is recommended as a suitable process for solving the needs of children from more sensitive groups [45]. The idea of inclusive education means a system open to all children which acts against the exclusion of any person from the economic, social, political or cultural life [46]. Significant progress of the examinees in our study in most of the observed variables indicates that even sports training can take place in inclusive conditions. For a more reliable conclusion, it would be useful to track the condition of motor abilities of exercisers from the “non-disabled” population, who have dedicated a lot of attention to the examinees (persons with MID) during this study and have frequently interrupted the continuity of their own training sessions. This raises the question if the “non-disabled” exercisers have managed to complete all the planned training goals, or whether, for the sake of contributing to the experiment, they have impeded the realization of their plans. Open questions remain whether and in what measure has working in inclusive conditions contributed to the progress of **social interaction**, and whether this effect would have been different if the examinees exercised in isolation from the exercises from the “non-disabled” population. The solution of this dilemma could be found by a future experiment including a control group.

The applied experimental program had a very positive effect on the general and specific motor

skills, which indicates that adapted karate is a suitable content for motor learning of persons with MID. Out of 18 karate variables in total, only for one of them statistically significant progress was not recorded – stance with parallel feet (*heiko dachi*). A possible explanation for this is the fact that persons with MID have the most difficulties with motor control of the body parts which are removed the most from CNS (in this case, the feet). In favor of this argument is the finding that the most improvement has occurred for the karate elements where hands are used, even in the more complex combinations performed in motion. In all of these tasks the dominant role was played by the upper part of the movement apparatus, while feet position was conditioned by the dynamics of the exercise. As a possible explanation for the lack of progress in *heiko dachi* element could also be lower motivation of the exercisers to perform static elements. This indicates that in training with persons with MID, it is better to apply dynamic exercises. This is in accordance with the basic goal of adapted karate – perfecting the motor skills on a wider scale and improving adaptive abilities significant for life in a real environment (not to provide a specialized teaching of karate techniques).

## CONCLUSIONS

The results of the study have proven the importance of systematic physical exercise for improving motor development and psycho-social status of persons with MID. Under the influence of a 12-week adapted karate program there has been a significant improvement of general and specific motor skills of the examinees, as well as **social interaction**. Dynamic exercises were more efficient from the static ones, where classic karate elements are applied. Sufficient explanation is lacking in which measure has working in inclusive conditions contributed to the changes in adaptive behavior, which is the reason for the realization of a new research with a control group, where the effects of exercise in inclusive and isolated conditions can be compared. The study has confirmed that persons of both sexes suffering from MDI can be included into the adapted karate program at the same time.

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