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The Effect of Practicing Taekwondo on Some Psychomotor Characteristics of Medical Students

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Abstract: *The profession of a doctor is a noble, demanding one, which involves many responsibilities and risks, but also a good knowledge of one's own body scheme, which involves motor adjustments that depend on mental activity. Through its content, the taekwondo course contributes to the knowledge, improvement and completion of specialized knowledge about the human body, its reactions to different stimuli and in complex moments, it can also contribute to the enrichment of knowledge about one's own reactions in extreme cases and their correction in favorable situations. Thus, practicing taekwondo in an organized setting helps us develop our coordination, neuromuscular elasticity, balance, agility, spatial-temporal orientation, effort capacity. In this sense, the research was carried out within the "Carol Davila" University of Medicine and Pharmacy on the groups that chose to take the taekwondo course. Purpose: This research wants to statistically highlight the effects of taekwondo, on some psychomotor characteristics, for medical students. Methods: The research was carried out on 130 students, who opted for the basic course in the sports branch of taekwondo, they had not previously practiced another sport in an organized setting, with height (168.35±6.97cm), weight (59.12 ±9.57 kg) and age (20.6±1.56 years). In carrying out this research, the test RCM1 (Complex Motor Reactivity 1) was used, administered as part of the initial test, at the beginning of the course in the first year, in the final test, at the end of the second year of study. Results: after processing the data, it emerged that taekwondo practiced in the basic course by medical students offers an increase in the indices of psychomotor characteristics by an average of 34.62%.*

Keywords: *taekwondo, martial arts, psychomotricity, recreational sport.*

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Introduction

Physical effort, practiced systematically and continuously, controlled and directed, represents an important bio-psycho-social stimulus that creates superior changes and adaptations in the human body (Mircică, 2020). From the point of view of the practice of bodily activities, the human individual mainly shapes his bodily being. The autoplastic characteristic comes from the motivation of the individual, from the intention to realize the harmonious development of his own body and, through this, to acquire a superior image of himself as a person. Engaging the body in movement, both on the dexterous and the less dexterous part, is characterized by a substantial contribution to the development and maintenance of functional capacities, to the preservation of the body's structures and to the limitation of their deterioration due to age and lack of stimulation. In the relationship between man and the environment, there is practically a functional asymmetry, laterality which translates as "the functional inequality of the right or left part (half) of the body" and corresponds to the difference in the development and distribution of the functions of the cerebral hemispheres. Physical movement, in general, is attributed to motor activity developed under a physiological and psychophysiological aspect. Thus, psychomotricity emphasises the mental regulation of motor skills, placing at the forefront the process of perception and the unity between perception and movement at the forefront (Epuran, 2011). In the sphere of psychomotricity, Epuran et al. (2001) include: body scheme, dynamic coordination, laterality, static coordination, perceptual-motor coordination, rapidity of movements and ideo-motricity. For right-handed people, language functions are located in the left hemisphere, and those of the body schema in the right (Grigore, 2001). Understanding the specifics of the psychomotor function requires the operation of the distinction between the moral and molecular aspects of the behavior, determining the movements, the motor acts and not the activity with a predominantly motor manifestation, as a whole (Mitrache & Bejan, 2019).

Perception in a psychomotor task can be visual, auditory or tactile in nature, and the motor response includes the use of one or more limbs, as well as the ocular or vocal systems (Chaiken et al., 2000). The medical profession, in general, is very demanding, both physically and mentally. The physical part is very demanding in emergency cases, the guards and the extended working hours, and mentally, he has to deal

with the emotional situations of the patients, giving them confidence. Thus, the medical student, during his training as a future doctor, must pay special attention to sports activities that involve mental aspects and are carried out ambidextrous, in an organized or independent way.

The increase in the incidence of chronic diseases, the lack of medical staff and crowded clinical environments, related to an increased demand for placement of students in clinical environments, reduce the opportunities for future doctors to learn psychomotor skills directly on patient care (Castanelli, 2009; Sears et al., 2010). Specialists in the field believe that because of the limited opportunities to develop psychomotor skills, there is growing concern among medical educators about new graduates who are not sufficiently competence in many of the basic psychomotor skills necessary for competent care (Gerrish, 2000; Hilton & Pollard, 2004; Salyers, 2007). These concerns require a reconsideration of strategies for teaching basic psychomotor skills in early medical education, starting from the first years of university (Ross, 2012).

Researchers from the University of Health Sciences, Florida, consider that psychomotor skills are important in surgery, the strong point in which integration becomes essential, a context of active performance, but they are also necessary outside the surgical field (Andreatta & Dougherty, 2019). Moreno & Mayer (2007) consider that there are many ways to facilitate the education of psychomotor characteristics, but it is recommended to use the one most suitable for surgical training programs. Trainees are encouraged to work on developing and consolidating skills as best as possible because there is a natural dynamic that occurs in all procedures, where some acts require great physical and mental effort caused by the complexity of the procedure itself or unforeseen internal causes (Moulton et al., 2010a,b). Researchers from the Ontario Institute for Educational Studies, University of Toronto, argue that the education of these psychomotor characteristics, especially for surgery, must start from the student period, completed and perfected later through a profession-specific expertise without sacrificing the quality of care and safety doctors as well as patients in the field of education (Hodges & Kuper, 2012).

Research Center for Medical Ethics and Law, Shahid Beheshti University of Medical Sciences, Tehran, Iran through a systematic review of the literature, which addressed the cognitive, affective and psychomotor skills of medical students, recognizing that these medico-legal issues can be prevented through appropriate education and

assessment, recommends that this field be considered a research priority and that effective educational policies be adopted in this regard (Abbasi et al., 2023).

From the literature subscribed to the medical field regarding the need for psychomotor characteristics, all researchers in the field agree that they must be developed at the highest possible level from the training stages (Changiz et al. 2021). At the same time, the existing literature emphasizes the benefits of taekwondo on psychomotor skills and mental health, but methodological gaps and the lack of studies focused on medical students limit the deep understanding of these effects in the context of medical education.

Problem statement

Medicine is accepted as one of the most respectable professions among the population, enjoying both respect and an honourable social status (Ben-Moshe, 2019). Although there is clear evidence that martial arts contribute to increasing self-confidence and improving emotional control, these researches are not specifically related to the specific needs and challenges of the medical profession (Mircică, 2020). Through this research we try to outline the importance of practicing a sport, in which exercises are used equally distributed, as dosage, on both sides left-right, from the first years of college for as long a period as possible.

The training of medical students is a process that has the task of obtaining maximum performance from each individual and achieving the planned basic objectives. Thus, the orientation of the training process should be considered a decisive factor in achieving subsequent professional successes. Through its content, the taekwondo course wants to contribute to the knowledge, improvement and completion of specialized knowledge about the human body, its reactions to different stimuli and in different situations. It can also contribute to the enrichment of knowledge about one's own reactions in extreme cases and their correction in favorable situations.

Practising taekwondo in an organised setting, being a particularly motor sport, in which emphasis is placed on dynamic and static coordination, ambidexterity, body scheme, agility, spatial-temporal orientation, motor reaction and ideo-motricity, leads to the maximization of the basic psychomotor parameters (Păunescu, 2018). The model of motor and psychomotor characteristics, exposed through expert evaluations, represents a kind of standard for the ideal

Taekwondo athlete (Asenov, 2023). Thus, sports mastery in taekwondo is determined by the degree of development of the qualities of speed-strength, resistance, agility, intermuscular coordination and other factors specific to the test and the weight category.

We must not forget the fact that it is necessary to follow both physical and spiritual results; we cannot delimit the physical part from the spiritual part, that's why many make mistakes and abandon the path of Martial Arts (Păunescu, 2007).

Research questions/aims of the research

The current research focused on identifying the way of action of taekwondo on some psychomotor characteristics, for the future profession of a doctor. Knowing that the technical actions and exercises used in taekwondo potentiate the practitioner, both physically and mentally, we consider that they can also emphasize the mental regulation of motor skills for future doctors. Thus, we hypothesized that medical students who participate in the taekwondo course during the first two university years can achieve substantial changes in some basic psychomotor characteristics for the medical profession.

Research Methods

Participants

The research was conducted on a number of 130 students (21 male students and 109 female students), of the "Carol Davila" University of Medicine and Pharmacy in Bucharest, Faculty of Medicine. The research subjects, with height (168.35 ± 6.97 cm), weight (59.12 ± 9.57 kg), and age (20.6 ± 1.56 years), chose to practice taekwondo, within the mandatory physical education and sport classes. The selection criteria imposed for the formation of the research group were: not to have previously practiced another sport in an organized setting and to voluntarily opt for the taekwondo course.

Materials

For the evaluation of the subjects in this research, we used the RCM1 test (Complex Motor Reactivity 1), test sample, designed in the form of a dynamic model made up of 38 sequences consisting of the combination of a maximum of 3 centrally located signal stimuli and a peripherally located signal stimulus, which consists in emitting

predetermined responses for each signal stimulus in a sequence. With the help of the RCM1 test, one can appreciate the level of self-control, sustained attention, emotional balance in situations of time pressure, tolerance to frustration, cerebral mobility, functional plasticity, regulation of execution speed to the dynamics imposed by the appearance of stimuli. The data analysis was carried out with the help of Microsoft Excel software (kutools) and IBM SPSS Statistics version 25.

Procedure

The subjects were tested in the Psychology and Psychomotricity Laboratory of the National University of Physical Education and Sport. An initial test was carried out at the beginning of the first year of courses, and a final test at the end of the second year of university courses. During the test, 4 red squares may appear on the screen, there are two variables: a) if the squares appear in the upper part of the screen, actuate the lever in the left/right hand depending on their positioning on the screen; b) if the squares appear in the lower part of the screen, actuate the pedals with the left/right foot depending on their position on the left or right side of the screen. These moves will be combined depending on the number of squares that appear and their position on the screen: right-left, up-down.

Another section of the test is when a green circle is observed in the upper-right part of the screen; from time to time with the appearance of squares on the screen the color will change from green to red, in which case no action will be taken to cancel the squares, but it will change as quickly as possible to the red color of the circle by pressing the right stick button. The characteristics evaluated with the help of this test are: working memory (fast retention and operation), learning capacity (quick adaptations to new perceptual conditions), perceptual field inspection (maintaining the state of alertness), perceptual-motor efficiency (the degree of efficiency of solving the task), trial performance (with reference to correctness and time), useful reaction time (the ability to trigger and execute in optimal periods), disruptive factor resistance (intense demand due to the unpredictable appearance of stimuli and the increase in the dynamics of the appearance) and time pressure resistance (regulation voluntary change of one's own dynamics to the dynamics imposed from the outside). The coefficient of resistance to time pressure is calculated by processing the scores obtained for the stimuli that unfold at a fast speed. It reflects the ability to trigger and execute motor operations under

conditions of imposed tempo, it involves the voluntary regulation of one's own movements in the context of increasing dynamics of situations.

The training of students in taekwondo was carried out according to the university curriculum for two university years with 2 hours per week. Training pallets and cushions, ladder, fence, stepper, cones, as well as protective equipment for working with a partner were used during the training.

Results and discussions

Results

Next, we present the data and the interpretation of the results obtained by the medical students in the RCM1 exam, according to the observed characteristic.

Learning capacity

Table 1. Descriptive statistics - Learning capacity

Test	Minimum	Maximum	Mean	Std. Error	Median	Std. Deviation	Mean difference
initial	1	5	2.93	.073	3	0.82	1.39
final	3	5	4.32	.059	4	0.67	

From the descriptive statistics for learning capacity, it can be seen that the minimum values increased substantially for the final test compared to the initial test, with a mean standard error of only 0.059. Also, the average values of the two tests indicate a difference of 1.39 in favour of the final test, which represents a statistically significant increase.

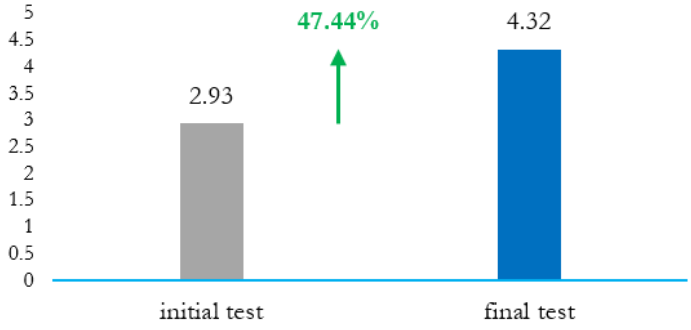


Figure 1. Comparison of the mean values of the two tests for Learning capacity

From Figure 1, by comparing the two averages of the initial and final tests, it is evident that the results of the subjects have improved on average by 47.44% compared to the initial test.

Working memory

Table 2. Descriptive statistics – Working memory

Test	Minimum	Maximum	Mean	Std. Error	Median	Std. Deviation	Mean difference
initial	1	5	2.94	.081	3	0.93	1.23
final	2	5	4.17	.062	4	0.70	

From the descriptive statistics for working memory, it can be seen that the minimum values have increased for the final test compared to the initial test, with a standard error mean of only 0.062. Also, the average values of the two tests indicate a difference of 1.23 in favor of the final test, which represents a statistically significant increase.

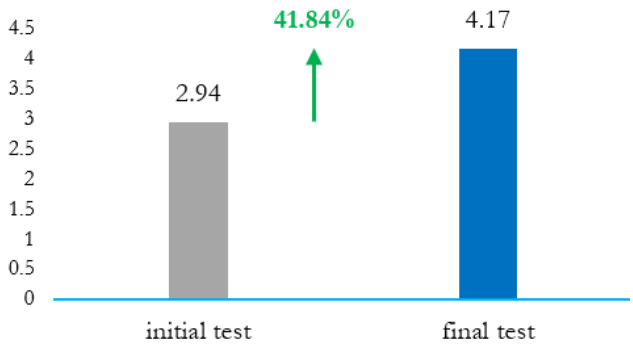


Figure 2. Comparison of the mean values of the two tests for Working memory

From Figure 2, by comparing the two averages of the initial and final tests, it is evident that the subjects' results improved by 41.84% on average, compared to the initial test.

Motor-Perceptual efficiency

Table 3. Descriptive statistics –- Motor perceptual efficiency

Test	Minimum	Maximum	Mean	Std. Error	Median	Std. Deviation	Mean difference
initial	1	5	2.95	.085	3	0.96	1.2
final	3	5	4.14	.058	4	0.66	

From the descriptive statistics for motor perceptual efficiency, it can be seen that the minimum values increased substantially for the final testing, compared to the initial testing, with an average standard error mean of only 0.058. Also, the average values of the two tests indicate a difference of 1.29, in favor of the final test, which represents a statistically significant increase.

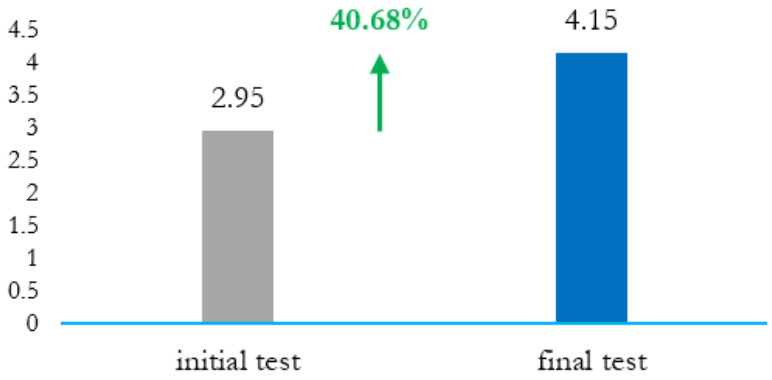


Figure 3. Comparison of the average values of the two tests for Motor perceptual efficiency

From Figure 3, by comparing the two averages of the initial and final tests, it is evident that the subjects' results improved by 40.68% on average, compared to the initial test.

Test performance

Table 4. Descriptive statistics –Test performance

Test	Minimum	Maximum	Mean	Std. Error	Median	Std. Deviation	Mean difference
initial	1	4	2.20	.432	2	0.49	1.05
final	2	5	3.25	.412	3	0.46	

From the descriptive statistics for the test performance, it can be seen that both the minimum and maximum values increased for the final test, compared to the initial test, with an average standard error of 0.412. Also, the average values of the two tests indicate a difference of 1.05 in favor of the final test, which represents a statistically significant increase.

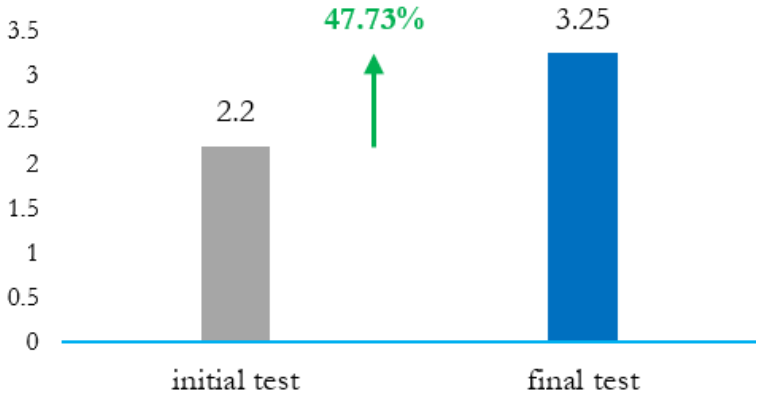


Figure 4. Comparing the average values of the two tests for test performance

From Figure 4, by comparing the two averages of the initial and final tests, it is evident that the results of the subjects have improved on average by 47.73% compared to the initial test.

Useful reaction time

Table 5. Descriptive statistics – Useful reaction time

Test	Minimum	Maximum	Mean	Std. Error	Median	Std. Deviation	Mean difference
initial	1	5	3.25	.067	2	0.76	1.04
final	2	5	4.29	.061	3	0.69	

From the descriptive statistics for useful reaction time, it can be seen that the minimum values increased for the final testing compared to the initial testing, with a mean standard error of only 0.061. Also, the mean values of the two tests indicate a difference of 1.04 in favor of the final test, which represents a statistically significant increase.

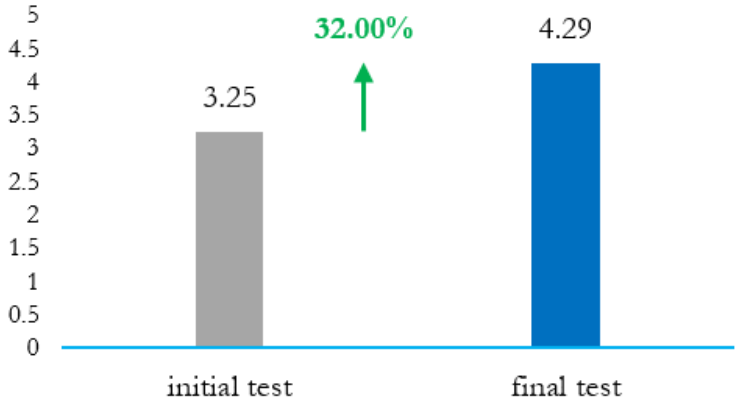


Figure 5. Comparison of the average values of the two tests for Useful reaction time

From Figure 5, by comparing the two averages of the initial and final tests, it is evident that the results of the subjects have improved on average by 32% compared to the initial testing.

Disturbing factor resistance

Table 6. Descriptive statistics – Disturbing factor resistance

Test	Minimum	Maximum	Mean	Std. Error	Median	Std. Deviation	Mean difference
initial	1	5	3.88	.095	4	1.08	0.88
final	2	5	4.76	.068	5	0.77	

From the descriptive statistics for disturbing factor resistance, it can be seen that the minimum values increased for the final testing compared to the initial testing, with a mean standard error of only 0.068. Also, the mean values of the two tests indicate a difference of 0.88 in favor of the final test, which represents a statistically significant increase.

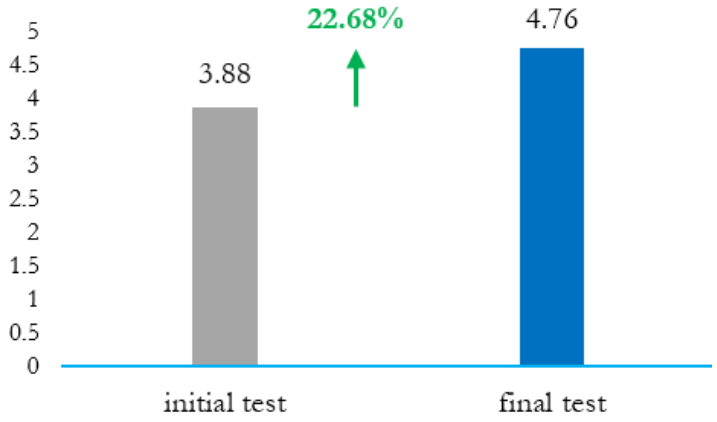


Figure 6. Comparison of the average values of the two tests for the resistance to the disturbing factor

From Figure 6, by comparing the two averages of the initial and final tests, it is evident that the results of the subjects have improved on average by 22.68% compared to the initial testing.

Resistance to time pressure

Table 7. Descriptive statistics – Resistance to time pressure

Test	Minimum	Maximum	Mean	Std. Error	Median	Std. Deviation	Mean difference
initial	1	5	3.20	.100	3	1.14	1.12
final	3	5	4.32	.071	4	0.74	

From the descriptive statistics for resistance to time pressure resistance, it can be seen that the minimum values increased substantially for the final testing compared to the initial testing, with a standard error mean of only 0.071. Also, the mean values of the two tests indicate a difference of 1.12 in favor of the final test, which represents a statistically significant increase.

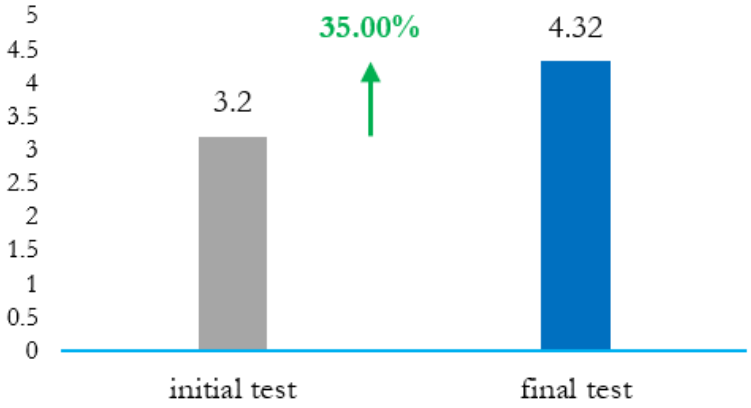


Figure 7. Comparison of the average values of the two tests for time pressure resistance

From Figure 7, by comparing the two averages of the initial and final tests, it is evident that the results of the subjects have improved on average by 35% compared to the initial testing.

Perceptual field inspection

Table 8. Descriptive statistics – Perceptual field inspection

Test	Minimum	Maximum	Mean	Std. Error	Median	Std. Deviation	Mean difference
initial	1	5	2.76	.071	3	0.78	1.42
final	3	5	4.18	.042	4	0.62	

From the descriptive statistics for the perceptual field inspection, it can be seen that the minimum values have increased substantially for the final testing compared to the initial testing, with a mean standard error of only 0.042. Also, the average values of the two tests indicate a difference of 1.42 in favor of the final test, which represents a statistically significant increase.

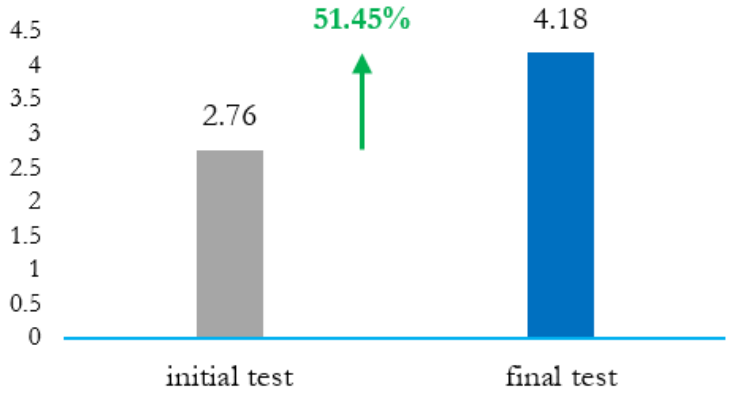


Figure 8. Comparison of the mean values of the two tests for perceptual field inspection

From Figure 8, by comparing the two averages of the initial and final tests, it is evident that the subjects' results have improved on average by 51.45%, compared to the initial test.

Discussions

The individual is a performing being by nature, due to the desire to surpass himself or to surpass others, which is a basic condition of his physical, mental and social development. The doctor of the contemporary society, in most cases, is subject to complex and exhausting situations, in emergency hospitals.

It is, therefore, essential to properly select the means of training to meet these future doctors' needs, which also includes the selection regarding the dominant composition of the bio-motor qualities and the preparation phase. The exclusive use of ambidexterity, especially in surgeons, can increase the quality of the medical act.

Knowing that in taekwondo, during the execution of all technical and tactical actions, both the lower and upper limbs are used, both the right and the left side. Thus, by going through the taekwondo specific program for the two years of study, within the Faculty of Medicine, it is necessary to strengthen some less developed skills on the less motor side, so that cerebral connections and psychomotricity improve. Rodriguez, (2010), a researcher in the Department of Psychology at Uppsala University in Sweden, argues that a person who can perform ambidextrous activities is a person who is able to use both hands equally, especially in tasks that require fine or detailed motor skills.

We believe that the present study contributes to the international literature investigating the beneficial effects of martial arts, such as taekwondo, on the development of psychomotor skills and stress management among students in intensive academic fields, such as medicine, providing functional perspectives on future jobs or specialties.

By highlighting the positive impact of taekwondo on psychomotor abilities, this article makes a significant contribution to global research that explores the intersection between sport and academic performance, supporting the integration of physical activities, with an emphasis on ambidexterity, in educational programs to improve later professional performance, right from the beginning of their career as resident doctors

Finally, we can say that the physical training of future doctors is inextricably linked to increasing the general level of the body's functional possibilities, to complex, complete and total physical development. The limits of this research are the four-year period until the graduation of the faculty and the small number of male students within the faculties of medicine. Another limitation might be that most of the existing studies focus on the general population or on high-performance athletes, leaving a gap regarding the specific effects on specialized academic groups, such as medical students. In this context, the novelty aspect is precisely the target audience on which the current research is being carried out within the Faculty of Medicine.

We mention that this research is part of doctoral studies, being approved by the organizing Institute for University Doctoral Studies – the National University of Physical Education and Sport in Bucharest, having the approval of the Department of Physical Medicine and Rehabilitation ethics council for the use of medical students from UMF "Carol Davila". At the same time, the students voluntarily participated in this research, and all ethical rules were respected in accordance with the principles of the Helsinki Declaration.

Conclusions

The research results provided useful information with significant differences for all targeted characteristics. We believe that, in specialisations such as surgery and dentistry, physical training is one of the most important factors, in some cases, the most important ingredient for achieving great operative performances, its objectives emphasizing the increase of the student's physiological potential and the

development of psychomotor abilities at the highest level. The physical part is very demanding both in emergency services and during extended working hours, while, mentally, the doctor, has to deal with the patients' emotional situations, giving them confidence.

Thus, organised taekwondo practice as part of the basic course for at least two academic years by medical students leads to an average increase of 34.62% in basic psychomotor characteristics. These improvements may reflect not only physical and psychological progress but also an increased capacity to adapt and respond under pressure, which is essential for their future medical careers.

Thus, taekwondo, when practised systematically within the basic university course framework for at least two academic years by medical students, provides an average increase of 34.62% in basic psychomotor characteristics. These improvements may reflect not only physical and mental progress but also an enhancement in adaptability and reaction capacity under pressure, skills essential for their future medical careers.

In conclusion, we can state that further research is required to examine the long-term effects and to provide specific data for professions that heavily rely on psychomotor skills, such as medicine.

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