

**SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI"
DEPARTMENT OF SPORT
SECTOR "INDIVIDUAL SPORTS AND RECREATION"**

VENTSISLAV NEDEV



**INFLUENCE OF MOTOR SKILLS AND ANTHROPOMETRIC
PARAMETERS ON THE ACHIEVEMENT OF SPECIFIC KARATE
PRECISION**

AVTOREFERAT



Sofia, 2023

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**ON THE DOCTORAL THESIS FOR AWARDING THE ACADEMIC
DEGREE OF "DOCTOR"**

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Methodology of Physical Education and Sport)**

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The scientific committee consists of the following members:

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The **doctoral thesis** consists of an **introduction, three chapters, conclusions, and recommendations**, with a **total** length of 187 pages. It is supported by 33 tables, 18 photographs, and 17 figures for visual representation. The bibliography includes 78 literary sources, with 40 in Cyrillic and 38 in Latin script.

The abstract (author's summary) follows the same structure as the doctoral thesis and has a length of 38 pages.

The defence of the doctoral thesis will take place on September 18, 2023, at 11:00 am in Hall No. 2 at the Rectorate of Sofia University "St. Kliment Ohridski."

CONTENT

1.1	PHYSICAL EDUCATION AND SPORT	8
1.2	SPECIFICITY OF KARATE PRECISION.....	12
1.2.1	Precision in Karate.....	12
SECOND CHAPTER: RESEARCH METHODOLOGY.....		18
1.3	SUBJECT, OBJECTIVES, AND HYPOTHESES OF THE STUDY	18
1.3.1	The subject of the study.....	18
1.3.2	The object of the study	18
1.3.3	The aim of the research	18
1.3.4	Research hypotheses.....	19
1.4	METHODOLOGY OF THE STUDY	21
1.4.1	Research Participants/Subjects	21
1.4.2	The variables examined in the study.....	21
1.4.3	Research Methods.....	23
1.4.4	Methods for data processing and analysis	24
CHAPTER 3: RESULTS AND DISCUSSION		26
1.5	RESULTS AND DISCUSSION - CADETS.....	26
1.6	RESULTS AND DISCUSSION – YOUTH.....	28
1.7	DIFFERENCES IN THE STUDIED AREAS BETWEEN CADETS AND JUNIORS.....	32
CHAPTER FOUR: CONCLUSIONS AND CONTRIBUTIONS		34
1.8	CONCLUSIONS.....	34
1.9	RECOMMENDATIONS.....	36
PUBLICATIONS RELATED TO THE DOCTORAL THESIS.....		37
DECLARATION OF ORIGINALITY/ AUTHORSHIP		38

INTRODUCTION

Every sport and athletic discipline have a specific nature that differs in its competitive structure. Therefore, there is a strong need for continuous research and practical testing of the specifics of certain sports, including primarily the genetic conditioning (limitations) of individual anthropological abilities and characteristics, followed by their hierarchical significance in sports, as well as their structure and development under the influence of specific training tools, methods, and loads.

From karate, as an ancient martial art, with the development and changing training conditions, karate sport evolves. The emergence of karate as a martial art represents a means of self-defense based on certain principles and laws. Its practice requires great physical and mental discipline.

The rapid development of karate is achieved due to improved material conditions for training, the development of technical aids, the implementation of the training process by professionals, proper planning and programming of suitable workouts, and timely selection of young categories for this sport. The study of karate helps develop a strong character and instills a sense of respect. The pursuit of better results leads to the introduction of new tools and methods, as well as the improvement of existing ones.

The process of achieving top sports results increasingly relies on scientific research and methods, establishing the factors that influence success and top sports performance. The significance of these studies in the field of karate lies in finding and determining the most economical and effective factors that are important for achieving high achievements.

Karate is a non-cyclic multi-technique sport that encompasses positions, strikes, blocks, movements, and all these elements combined in continuous synchronization of actions. In karate, striking techniques dominate. That is why, in mastering karate technique, special emphasis is placed on improving striking techniques, which are the only techniques for scoring in sport combat. Due to

the various unforeseen and numerous situations that arise in sport combat, there must be completeness in all the components involved. Therefore, right from the beginning of the training process, it is directed towards the formation, development, and improvement of anthropological and motor dimensions, as well as situational karate techniques and specific elements of karate.

To achieve the desired goal, the maximum amount of information is necessary, which should be properly integrated and utilized in the process of building the karateka's personality. For the process to be successful, existing templates need to be improved and based on real examples, practical and scientific achievements that allow an objective valorization of the elements important for transforming the mentioned dimensions. Therefore, a continuous connection between theory and practice needs to be established so that karateka can continually enhance their capabilities and achievements.

Karate, as a multi-technique non-cyclic sport characterized by non-predictable movements, only symbolically eliminates the opponent. This "positive elimination" is what the karateka aims to achieve by delivering controlled strikes to the head and body of the opponent, even though the movements involve a combination of maximum and sub-maximum intensity. It is precisely this symbolism that gives special significance and importance to this sport.

CHAPTER 1: LITERATURE REVIEW

1.1 PHYSICAL EDUCATION AND SPORT

We can trace and study physical culture only as an integral part of general culture and the social life of humans; therefore, it is a socially-historical and dialectical category and as such is inherently dependent on the development of productive forces and social relations.

There are many sources from which information is drawn and the history of physical culture is constructed. These sources primarily include written, and material remains, as well as traditions associated with human history itself. Works by Aristotle, Lucian, Plutarch, Xenophanes, Herodotus, Plato, and later Rabelais, Montesquieu, Locke, Rousseau, Comenius, Pestalozzi, and Belinsky are known to leave a rich trace in Physical Culture, supported by drawings, diagrams, and archaeological remains. Equally important for the history of physical culture are the studies associated with tradition, conducted by many ethnologists around the world and in our country.

The historical development of physical culture is closely related to the periods that are characteristic of the development of society itself. Contemporary historiography examines the history of society in five stages, each of which has its specific level of development of productive forces and social relations, as well as a specific social structure that fully determines the social activity of individuals and, consequently, the activities in physical culture. In all five social orders: primitive communal, slave-owning, feudal, capitalist, and socialist, activities in the field of physical culture, and therefore physical education as its domain, have their own characteristics and significantly differ when realized among people.

The various scientific studies that explain the origin and development of human beings and society demonstrate and explain the assumptions that different forms of physical culture and social practices are present in all stages of social development, from its formation to the present day.

Physical culture, as part of human culture, represents a significant element in the overall life of modern humans. As a human activity, it is also an integral part of human society and a subsystem within the multitude of systems in human life and activity. Physical culture itself cannot exist in isolation, but as a system, it has its own autonomy and consists of four clearly delineated subsystems.

These subsystems are:

- Physical education
- Sport
- Sport recreation
- Kinesiotherapy.

The aforementioned subsystems represent specific forms of human activity, which, with their numerous methods and forms of work, mutually support and comprise the unique system of physical culture. However, their differences are evident, primarily in their goals - tasks, methods of professional work, competition systems, modes of financing, and many other structural distinctions.

It is worth noting that physical culture as a complex system is not a static category (considering the subsystems as such), as confirmed by its activities, which are directed towards individuals who undergo daily changes. Therefore, this division of physical culture into its four subsystems should be understood as dynamic and evolving.

As mentioned earlier, physical education has existed since the earliest periods of human society's history. Its development as a social phenomenon is determined by people's knowledge. In its initial appearance, it has a spontaneous character, but it then acquires its own direction. Changing the historical context, with the development of society, improvement of living conditions, and social attitudes of people, physical education gradually becomes integrated into the system with specially developed content, specific means, methods, and forms of work aimed at the education, upbringing, and training of the youth.

In modern times, the system of physical education falls into the category of social systems. Through its functioning, it undoubtedly achieves significant social goals that are important for the development of both individuals and society as a whole. That is why physical education, as a sport-educational process, is a complex and responsible activity through which society organizes the development of individuals in physical and spiritual aspects. The emergence of upbringing, education, and training as types of pedagogical activities is of essential importance. They continuously develop and improve parallel to the development and advancement of society. The numerous pedagogical activities themselves are interconnected, and as part of the system of physical education, upbringing, education, and training serve as a means to achieve specific goals presented in the curricula for physical exercises and sports both within and outside the classroom. These goals are connected through the spiritual and practical needs of society:

- Upbringing is a means of creating individuals who possess certain moral values and virtues.
- Education is a means of creating individuals who possess knowledge about reality.
- Training is a means of creating individuals who possess practical knowledge, habits, as well as related manifested motor skills.

Within the system of physical education, individual elements function to achieve harmonious development, a healthy lifestyle, the formation of specific knowledge, motor habits, and the development of motor and moral qualities of the individual.

The field of physical education, as a part of physical culture, is an integral part of the entire educational process in schools.

Due to its function, it holds a special place and significance for the biological-health, educational, labor-protection, and socio-psychological functions of children in preschool and school age, as well as students.

1.2 SPECIFICITY OF KARATE PRECISION

1.2.1 *Precision in Karate*

Precision is a motor ability that allows the execution of targeted and dosed movements. Achieving precise movements in combat positions requires good coordination. This is why precision has long been considered a component of coordination (Zaciorski V., 1975). From this, it follows that motor precision is associated with the accurate assessment of spatial and temporal parameters of the movement system. According to Kostovski Z., precision also depends on the perceptual control of muscle activity, which has optical and kinetic characteristics (Kostovski Z., 2004).

Accuracy in sports is an intriguing area of research that focuses on improving performance through increased precision, consistency, and control in various sports activities. Accuracy can be classified in different ways, indicating many different types of precision.

Based on the speed of execution, we can differentiate between fast and slow precise movements. Fast precise movements include sports such as karate, boxing, tennis, fencing, and others, while slow precise movements include sports that require hitting a target.

Based on the duration of precision, we can distinguish between long-term precision, such as a tennis match lasting several hours, and short-distance precision, such as in karate, fencing, and others.

Based on the type of limb involved, we can differentiate between hand precision or leg precision. Hand precision does not always imply leg precision in sports such as basketball, handball, boxing, tennis, and others, and vice versa, leg precision does not always imply hand precision, as seen in football. In karate, where precise techniques of striking with hands and legs are performed,

accuracy is of great importance for both limbs. There are numerous factors that contribute to accuracy.

Good perception and analysis of visual signals in the central nervous system are crucial for accuracy. Without them, good accuracy cannot be achieved.

Accuracy also depends on the required level of force. No movement can be executed without a certain level of force, so achieving accuracy in executing a striking technique with the hand or leg requires imparting an impulse with the necessary muscle strength to reach the target.

Balance is also an important factor, referring to the ability to maintain a balanced position. When balance is compromised, the conditions for executing dosed and precise movements become challenging.

Emotional state significantly influences accuracy. Individuals who are calm and can control their emotional state tend to have better accuracy. Excessive excitement and feeling too responsible for the outcome of the movement can disrupt accuracy.

Attentional focus, or the ability to concentrate on executing the movement, is a crucial factor for accuracy. When working with preschool-age children, special attention should be given to this factor, as their concentration abilities are weaker.

In addition to the multitude of factors, accuracy also depends on training, age, gender (girls tend to be slightly more accurate than boys), the distance between opponents in combat sports, and distracting factors such as noise (audience noise, waving hands, and others).

The development of accuracy. Accuracy is largely inherited, but it is also acquired to some extent. Accuracy is the least researched segment in the motor domain. Although precision as a motor dimension has not been experimentally

confirmed and appeared relatively early in the literature as a term, it is one of the aspects of coordination or as a aspect of neuro-muscular control. There are different measurements of precision: object tracking precision and precision in object throwing. However, in martial arts, we talk about precision in executing strikes with hands and legs without the use of objects.

As confirmed in most previous studies, precision tests are among the measuring tools for assessing motor abilities that have the weakest reliability measures. This is one of the main reasons why it is considered impossible to isolate precision as a separate motor dimension within a factorial or logical model. According to all competition rules in all disciplines of martial arts (kumite, kogo-kumite, jiu-kumite, kihon-kumite), precise and controlled strikes with hands and legs are of great importance in Traditional Karate. Therefore, special attention should be paid to the training process. It is not only about the techniques of striking with legs and hands, but also the techniques of evading and counterattacking depend on the improvement of precision to achieve better performance in martial arts. Special training programs can significantly influence the improvement of precision in all executed techniques in the martial arts disciplines of Traditional Karate.

1. Improving precise and controlled striking can be practiced on a stationary or moving target, as well as on a target that appears and hides:
 - A stationary target can be the opponent when they are in a fighting stance.
 - A moving target can be when the opponent is moving in a given space.
 - A target that appears and hides is a situation where the opponent presents a surface for strikes and then conceals it in motion.
2. Precise, controlled, and timely delivery of strikes in all of these situations is a particular skill. Strikes can be executed from a stationary position or

while in motion, so the refinement of precise, controlled, and timely striking should be done gradually:

- Strikes are executed at a specific point on a prop such as (makiwara, punching bag, focus mitts) from a stationary position, first at the same location, and then at different combat distances.
- The same strikes are executed on the same prop while in motion and at different combat distances.
- Strikes are executed on moving props like a swinging punching bag in the frontal plane relative to the practitioner.
- Strikes are delivered on focus mitts or pads held by the trainer, occasionally lifted or lowered.

A higher level of refinement for precision, control, and timing in strike execution is direct striking on a partner who is in a fighting stance and moving.

3. The level of preparedness for precision, control, and timing of strikes can be assessed through a simple precision test, such as using a tennis ball suspended on a string. The height at which the ball is placed is determined by the practitioner's height. The ball is allowed to freely fall, following the pendulum principle in the frontal plane, or the ball is held in a vertically hanging position, and the practitioner executes the strike at the most convenient moment. Out of 10 attempts, achieving more than 7 successful strikes is considered good preparation.

Precision is the least researched segment of the motor domain, and for a long time, it was considered to be a form of coordination between the hand-eye and foot-eye systems. Given that precise movements originate from higher brain centers and are performed under subvisual control, precision cannot be regarded as a component of coordination as a separate motor ability.

Precision is the ability to perform accurately targeted and dosed movements in complete accordance with the set task. It manifests in motor actions that require the alignment and control of the body, body parts, or the target object.

It depends on the ability to accurately assess the spatial and temporal requirements of a given motor task and evaluate the optimal force with which one should act. All these highly complex processes in our centers make decisions within tenths and hundredths of a second. These processes are not always perfect, so until the centers work fast enough, there is no possibility for timely commands to make eventual corrections in the movement to achieve the goal.

Precision in the motor domain is demonstrated as:

- Launch precision when throwing an object (hitting a ball at an angle, throwing into a target, etc.).
- Placement precision when consciously directing an object or body part towards the target (strikes in combat sports, fencing, etc.).

In practice, there is a third factor that is a combination of the previous two, known as precision launching-placement (for example, in football, the ball is first prepared, which represents placement, and then the target is hit with the ball, which represents launching). Around the age of 25, approximately 80% of the maximum development of precision is reached. Precision is crucial in sports, especially where hitting the target is essential. Coordination, also known as motor intelligence, controls movements and is expressed through fast and accurate execution of complex motor tasks, as well as solving motor problems in the fastest possible time. To solve tasks that demonstrate these abilities, synchronization between the higher-level regulatory nerve centre and its connection with the peripheral part, which influences the mobility system, is necessary. Precision is the ability of the nervous system to control fine internal-

muscular coordination, which harmonizes muscle contractions in terms of their mutual participation in movement and the ability to dose the contraction of each muscle. That is why precision has long been considered a component of coordination. Precision can be classified in various ways, meaning there are many different types of precision: based on the speed of execution, there are fast and slow precise movements (fast: strikes in tennis; slow: target shooting). According to the duration of precision, there is long-term precision and short-term precision. Depending on the type of extremity, there is hand precision or foot precision. Hand precision does not necessarily imply foot precision. There are several factors that affect precision. The analysis of visual signals in the central nervous system is essential for precision. Without them, good precision cannot be achieved. It also depends on the necessary level of force. Respondents who performed better in the standing long jump test (ability to mobilize the most energy per unit of time) achieved better results in the criterion variable of a hand strike (Zaku Tsuki) on a moving target in the frontal plane. No movement can be performed without an appropriate level of force. Balance is an important factor, i.e., the ability to maintain a balanced position, as disrupted balance makes it difficult to perform precisely dosed and accurate strikes. Unfortunately, this study did not include motor tests to assess balance. Emotional state significantly influences precision. Individuals who are calm and able to control their emotional state exhibit greater precision. Excessive excitement and feeling a high level of responsibility for the outcome of the movement impair precision. Concentration, which is the ability to focus on performing movements, is an important factor for precision. In addition to numerous factors, precision depends on training, age, gender (girls tend to be slightly more precise than boys), distance and size of the target, and factors that hinder precision such as sound, noise (audience noise, hand movements in front of the shooter, etc.).

SECOND CHAPTER: RESEARCH METHODOLOGY

1.3 SUBJECT, OBJECTIVES, AND HYPOTHESES OF THE STUDY

Due to the nature of the sport, which is characterized by complex movements and explosive actions that are crucial in specific situations during sports competitions, continuous research is necessary to explain these phenomena. Karate belongs to the group of sports that have a significant impact on the transformation of the individual as a whole. Regular practice over a long period of time influences the optimal development of the athlete, improves the structure of the psychosomatic status, and affects the anthropometric and motor measurements of the athletes.

1.3.1 The subject of the study

According to the above, the subject of the study is the specific anthropometric measurements, motor skills, and specifically motor abilities of karate practitioners engaged in traditional karate.

1.3.2 The object of the study

The object of the study is the predictable values of variables from the predicate system, specifically the coordination in karate for karate practitioners. The study aims to uncover the relationships between the studied variables across different age categories of athletes.

1.3.3 The aim of the research

Analyzing the existing research and the subject and problem of the study, it becomes apparent that as much information as possible is needed to provide reliable support for successful work.

The objective of the research is to investigate the impact of specific anthropometric parameters and motor skills on the achievement of specific karate precision.

Based on the subject and objective of the study, the following specific tasks were carried out:

- To examine the problem through a review of the literature.
- To investigate the practical aspects.
- To analyze the obtained results and determine which prognostic variables from the motor domain have the highest statistically significant impact on the performance of specific karate precision.
- To analyze the results of anthropometric measurements and determine which variables from the anthropometric domain have the highest statistically significant influence on the performance of specific karate precision.
- To investigate which variables, whether anthropometric or motor variables (applied as a predictive system of variables in this study), are reliable in explaining the problem.
- To establish the significance of the information obtained from the study for theoretical and practical applications.

1.3.4 Research hypotheses.

Based on the subject, problem, objective, and tasks of this research work, as well as the results of previous studies, the following hypotheses can be distinguished:

X0 - No statistically significant predictive values are expected between the investigated spaces of the predictive variable system (anthropometric parameters and motor abilities) and the criterion variables for specific precision in karate.

Starting from the null hypothesis, the following individual hypotheses can be formulated:

X1 - A statistically significant correlation is expected between the investigated anthropometric parameters and specific karate precision.

X2 - A statistically significant correlation is expected between the investigated motor skills and specific karate precision.

X3 - Statistically significant differences are expected in the variables assessing the range of motion between the investigated karate groups (cadets and juniors).

X4 - Statistically significant differences are expected in the variables assessing the specific precision of karate between the investigated karate groups (cadets and juniors).

1.4 METHODOLOGY OF THE STUDY

1.4.1 Research Participants/Subjects

The study was conducted on the best male karate practitioners with brown and black belts, cadets (aged 14-16) and juniors (aged 17-18), who were members of the national teams of the Traditional Karate Federation. A total of 63 cadet and junior karate practitioners from the entire territory of the Republic of North Macedonia were included. In order for the participants to be included in the study, they needed to meet the following criteria:

- They had to be physically and mentally healthy on the day of assessment.
- The participants had to have at least 2 years of training and competition experience, which was considered a sufficient indication that they had developed a motor skill set in karate.
- They had to regularly attend training sessions in their clubs and national teams.
- During the measurements, they were required to perform the assigned tasks with maximum precision and conscientiousness in order to obtain a realistic picture of the actual situation.

1.4.2 The variables examined in the study

In this study, the measurement instruments used were divided into two groups:

1. Predictor variable system: This system consisted of certain anthropometric characteristics, including three variables for assessing longitudinal-dimensionality and nine variables for assessing basic motor abilities. The motor variables were divided into three measures in the motor spaces specific to karate sports, including rhythmic structure,

segmental movement frequency, and explosive power of the lower extremities.

2. Criterion variable system: This system consisted of four variables for assessing the specific precision of karate.

Anthropometric variables were measured following the methodology recommended by Kurelich et al. (1975), while motor variables were assessed according to the methodology of Metikosh et al. (1989). Variables for assessing the specific precision of karate were measured using the methodology of Kostovski (2004).

Table 1. Variables for assessing longitudinal dimensionality¹

<i>Test 1.</i>	Height	(AVIS)
<i>Test 2.</i>	Arm length	(ADRA)
<i>Test 3.</i>	Leg length	(ADNO)

Table 2. Variables for assessing fundamental motor abilities.

Variables for assessing movement frequency	
1.Hand tapping for 10 seconds in the sagittal plane	HT 10
2.Foot tapping for 10 seconds in the sagittal plane	FT 10
3.Wall foot tapping - Variable for assessing rhythm	FT 3
4. Non-rhythmic hand striking	NRHS
5.Non-rhythmic foot striking	NRFS
6.Strikes and defenses - Variable for assessing explosive power of the lower limbs	MYHO
7.Standing long jump	SLJ
8.Standing vertical jump	SVJ
9.Kick forward (mae geri) from a squat position	MUFGK

¹ Longitudinal and transverse dimensionality refers to the longitudinal and transverse skeletal dimensions; o Обем на тялото и мастна тъкан. 2) Функционални способности на орган и органи.

Table 3. Variable for assessing specific karate precision.

1.Hand strike (Gyaku) on a moving target in the sagittal plane	(URMSR)
2.Hand strike (Gyaku) on a moving target in the frontal plane	(URMFR)
3.Kick (Mae Geri) on a moving target in the sagittal plane	(UNMSR)
4. Kick (Mae Geri) on a moving target in the frontal plane	(UNMFR)

1.4.3 Research Methods

1.4.3.1 .Description of circular dimensionality²

The description of the tests for measuring anthropometric values

The anthropometric measurements were performed using instruments that were standard-made and calibrated prior to the start of the measurements. The measurement of the length of the arms and legs of the participants was conducted on the left side of their body.

1.4.3.2 Description of the tests for assessing basic motor skills

1. Non-rhythmic Hand Strikes (NRHS);
2. Non-rhythmic Leg Strikes (NRFS);
3. Strikes and Blocks (SAB);
4. Tapping with Hand in Sagittal Plane (TWHSP);
5. Tapping with Leg in Sagittal Plane (TWLSP);
6. Tapping with leg on wall (TWLW);
7. Standing long jump (SLJ);
8. Standing vertical jump (SVJ);
9. Front Kick (mae geri) from a Squatting Position" (FKSP).

1 ² циркулярната дименсионалност-за кръгова размерност и телесна маса: обиколка на предмишницата (АОРОД), обиколка на горната част на ръката (АОНАД), обиколка на долната част на крака.

1.4.3.3 Description of the intentions of the variables for assessing specific karate precision

1. Punching (gyaku tsuki) at a moving target in the frontal plane (URMFR);
2. Punch with hand (gyaku tsuki) at a moving target in the frontal plane (URMFR);
3. Kick with leg (mae geri) at a moving target in the sagittal plane (UNMSR);
4. Kick with leg (mae geri) at a moving target in the frontal plane (UNMFR);

1.4.4 Methods for data processing and analysis

The characteristics and sample size of the selected participants, as well as the research objectives, problem statement, and hypotheses of this study, determine the main methods of data processing employed. The collected data were processed using software systems for univariate data analysis. The analyses were performed using the Statistics 6.0 program and the SPSS 12.0 program, along with appropriate subroutines where necessary. The variables used in the study were subjected to descriptive procedures, and basic central tendency and dispersion parameters were calculated to determine the distribution function and key parameters for all studied variables: minimum values (Min), maximum values (Max), mean (Mean), and standard deviation (SD).

For assessing normality and distribution of the data, measures such as skewness, kurtosis, and the Kolmogorov-Smirnov test were employed. In addition to basic statistical parameters, correlation coefficient (R) and partial correlation (PART-R) were calculated for the entire system of variables. The impact of the predictor variables on the criterion variables was evaluated using multiple regression analysis. Regression analysis was applied to determine the

influence of anthropometric measurements and basic motor abilities, represented as predictor variables, on the specific accuracy of karate as the criterion. Calculations included multiple correlation coefficient (R), determination coefficients, regression coefficients (BETA), standard error of prediction (SIGMA), and the significance level of partial regression coefficients (BETA). To test the hypothesis that the true value of the multiple correlation coefficient is actually zero, the F-test was conducted.

Multivariate methods such as ANOVA (Analysis of Variance) and MANOVA (Multivariate Analysis of Variance) were used to examine possible differences between the studied karate practitioners (cadets and juniors) in terms of variables related to movement space and variables assessing specific karate coordination.

CHAPTER 3: RESULTS AND DISCUSSION

The values of the statistical indicators in most of the applied variables fall within the usual boundaries that have been observed in previous studies. This applies to previous studies that have similarities in defining the respondents based on age, gender, and other characteristics, similar to the respondents included in this study.

1.5 RESULTS AND DISCUSSION - CADETS

During data collection, I adhered to all general methodological requirements for well-planned and executed research. After data entry into the matrix, an initial analysis of the data was conducted, including logical checks of the measurement lists, matrix, and identification of illogical or obviously incorrectly measured and entered data (outliers) for correction or removal. This was followed by the interpretation of the data distribution and examination of potential reasons for any statistically significant deviations from the normal distribution according to Gauss.

Table 4 presents the results of the main descriptive statistical parameters for the cadet karate practitioners. Based on the obtained results, we can conclude that there are no significant deviations from the logically expected values.

Regarding the distribution asymmetry of the results, Table 4 shows slightly more pronounced values for the variable A_{DPA} (1.64118). For the other variables, symmetric distributions have been observed in terms of asymmetry of distributions.

Significant elongation (sharpness) of the peaks of the result distributions has been observed in the same variable A_{DPA} (3.43687). For the other variables applied in this population of subjects, a decrease in the distribution of the

variables is observed. This indicates pronounced homogeneity in the achieved results among the surveyed individuals.

The values of the basic central and dispersion parameters of the applied variables within the minimum (Min) and maximum (Max) ranges contain approximately four or more standard deviations (SD), indicating satisfactory sensitivity of all variables. Based on the value derived from the standard deviation (SD) and its ratio to the mean value (Mean), it can be concluded that for most variables, there is no statistically significant deviation of the results from the mean value.

The numerical values of the standard error show minimal deviation since, proportionally speaking, they are insignificant compared to the respective standard deviation value.

Table 4. Descriptive Statistics - Cadets

	Mean	Minimum	Maximum	Std. Deviation.	Skewness	Kurtosis
MTR10	23.871	19	32	3.03031	0.66164	0.24429
MTN10	13.7419	10	18	2.1904	0.5356	-0.2268
MTNZ	28.129	21	38	4.55882	-0.0961	-0.7967
MNUR	15.6452	10	24	3.96273	0.32288	-0.9737
MNUN	7.93548	2	15	2.60686	0.28052	1.01938
MUIO	5.41935	3	9	1.45543	0.51739	0.03186
MSMD	188.032	155	245	23.7872	0.6672	-0.3884
MSMV	33.8387	25	48	6.76805	0.58549	-0.7988
MUMGK	4.22581	3	5	0.66881	-0.2915	-0.6743
AVIST	168.032	158	179	6.03591	0.28052	-0.9291
ADNO	89.3548	60	105	10.8491	-1.0338	0.73767
ADRA	71.0645	60	102	9.50065	1.64118	3.43687
AMAST	64.6774	37	102	14.0128	0.9033	1.36281
URMFR	9.6129	7	12	1.17409	-0.092	-0.4609
UNMSR	8.54839	5	11	1.33763	-0.0658	0.91119
UNMFR	7.83871	6	11	1.15749	0.47283	0.21353
URMSR	9.06452	8	10	0.57361	0.01532	0.33554

1.6 RESULTS AND DISCUSSION – YOUTH

Table 5 presents the results of the basic descriptive statistical parameters for the youth karate athletes. Based on the obtained results, we can conclude that there are no significant deviations of the results from the logically expected values.

In Table 5, regarding the skewness of the distribution of the results, slightly more pronounced values are observed for the variable АДРА (1.64118). For the other variables, symmetric distributions are observed in terms of skewness. Significant elongation (kurtosis) of the peaks of the result distribution is observed in the same variable АДРА (3.43687). For the other variables applied in this group of participants, a certain pronounced flatness of the

distribution of the variables is observed. This indicates a pronounced homogeneity in the achieved results among the studied individuals.

The values of the basic central dispersion parameters and variance parameters of the applied variables within the minimum (Min) and maximum (Max) ranges contain approximately four or more standard deviations (SD), indicating satisfactory sensitivity of all variables. Based on the values of standard deviation (SD) and its ratio to the mean (Mean), it can be concluded that for most variables, there is no statistically significant deviation of the results from the mean.

The numerical values of the standard error indicate minimal dispersion, as they are insignificant relative to the corresponding value of the standard deviation.

Deviation in the achieved results of the cadet karate athletes is shown in Table 6. According to the results obtained from the Kolmogorov-Smirnov test, it can be concluded that there is a significant deviation in the applied variables in three cases. Statistically significant deviation of the results is observed in the variables MYMГK ($p < .01$), YHMCP ($p < .05$), and YPMCP ($p < .01$). Normal distribution is observed in the results of the other applied variables among the cadet karate athletes.

Despite being a small and selective group of respondents (karate juniors), the analysis results indicate that most of the variables have a normal distribution of their results. Based on this, it can be concluded that the degree of normality in the distributions of the applied variables satisfies the necessary methodological and statistical criteria for the application of correct and justified multivariate and univariate statistical procedures for further processing of the obtained data. In fact, this creates conditions for sufficiently accurate scientific determination, analysis, and comparison of the data.

Table 5. Basic Statistics - Boys

	Mean	Minimum	Maximum	St.deviation.	Skewness	Kurtosis
MTP10	23.1875	19	30	2.87859	0.71737	0.05226
MTN10	13.7188	10	17	1.68933	-0.0403	0.23643
MTNZ	30.8125	20	38	4.46808	-0.7012	-0.0421
MNUR	18.5	11	27	4.27295	0.32682	-0.7141
MNUN	6.59375	5	10	1.36451	1.13076	0.98546
MUIO	4.90625	3	7	1.17389	0.31993	-0.6254
MSMD	214.219	170	250	22.1108	-0.4642	-0.2625
MSMV	36.6563	28	50	6.24556	0.21797	-1.0134
MUMGK	4.0625	3	5	0.5644	0.02691	0.44177
AVIST	180.594	161	194	7.83647	-0.396	-0.1236
ADNO	99.0313	91	110	5.43278	0.48522	-0.7177
ADRA	73.7813	67	80	3.17992	-0.0246	-0.2439
AMAST	82.5938	55	107	13.4185	-0.1794	-0.5182
URMFR	10.2813	8	12	0.88843	-0.6063	0.02266
UNMSR	7.96875	6	9	1.03127	-0.4991	-1.0007
UNMFR	7.65625	6	9	1.12478	-0.2722	-1.2767
URMSR	9.03125	7	11	0.89747	-0.0639	-0.3551

Table 6. Basic Statistics - Cadets Kolmogorov-Smirnov Test

	N	Max	Diff	p
MTP10	32	0.19127	$\pi < .15$	
MTN10	32	0.15986	$\pi > .20$	
MTNZ	32	0.11049	$\pi > .20$	
MNUR	32	0.10908	$\pi > .20$	
MNUN	32	0.23077	$\pi < .05$	
MUIO	32	0.18692	$\pi < .20$	
MSMD	32	0.14309	$\pi > .20$	
MSMV	32	0.16923	$\pi > .20$	
MUMGK	32	0.35659	$\pi < .01$	
AVIST	32	0.11424	$\pi > .20$	
ADNO	32	0.11781	$\pi > .20$	
ADRA	32	0.09046	$\pi > .20$	
AMAST	32	0.08451	$\pi > .20$	
URMFR	32	0.25949	$\pi < .05$	
UNMSR	32	0.24759	$\pi < .05$	
UNMFR	32	0.2138	$\pi < .10$	
URMSR	32	0.20486	$\pi < .15$	

1.7 DIFFERENCES IN THE STUDIED AREAS BETWEEN CADETS AND JUNIORS

According to the results in Table 7 and Figure 1, which shows the t-tests between cadet and junior karate athletes in motor skills, statistically significant differences have been observed in the variables: MTNZ, MNUR, MNUN, and MSMV. In these four variables, the results favor the junior karate athletes.

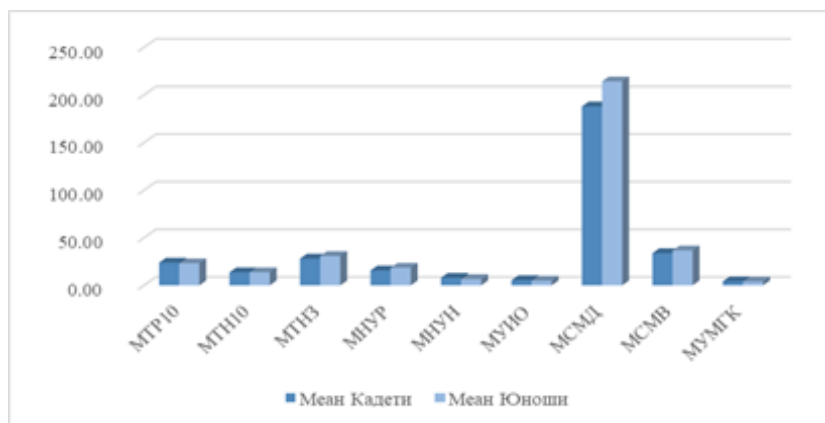


Figure 1. Graphical representation of comparative analysis using t-tests between cadets and boys in motor skills.

Table 7. T-tests between cadets and boys in motor skills.

Variables	MeanK	MeanJ	Std.DevK.	Std.Dev.J	t-value	p
MTR10	23.87	23.19	3.03	2.88	0.92	0.36
MTN10	13.74	13.72	2.19	1.69	0.05	0.96
MTNZ	28.13	30.81	4.56	4.47	-2.36	0.02
MNUR	15.65	18.50	3.96	4.27	-2.75	0.01
MNUN	7.94	6.59	2.61	1.36	2.57	0.01
MU10	5.42	4.91	1.46	1.17	1.54	0.13
MSMD	188.03	214.22	23.79	22.11	-4.53	0.00
MSMV	33.84	36.66	6.77	6.25	-1.72	0.09
MYMGK	4.23	4.06	0.67	0.56	1.05	0.30

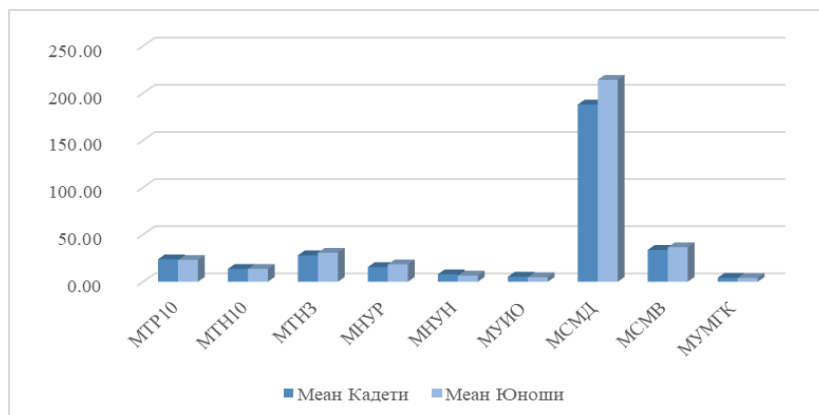


Figure 1. Graphical representation of comparative analysis of t-tests between cadets and juniors in motor skills.

CHAPTER FOUR: CONCLUSIONS AND CONTRIBUTIONS

1.8 CONCLUSIONS

Based on the results obtained in this study, which was conducted with two groups of karate practitioners: cadets and juniors, the following CONCLUSIONS can be drawn:

Regarding the established influence of the predictor system of variables on the criterion variables for assessing specific karate hand precision, specifically with the variable Hand Strike (Gyaku Tsuki) in a moving sagittal plane target (URMSR), a statistically significant prediction of anthropometric and motor variables on the criterion was found among cadet karate practitioners.

In the remaining three relationships, no statistically significant prediction of the predictor anthropometric and motor variables on the criterion variables for assessing specific karate precision was found among cadets.

Regarding the null hypothesis stated in the study, which states that X_0 - no statistically significant predictive values are expected between the investigated spaces of the predictor system of variables (anthropometric measurements and motor abilities) on the criterion variables (specific karate precision), it is partially accepted, i.e., only in one segment.

Regarding the first two hypotheses set in the study, which state X_1 - a statistically significant correlation is expected between the treated anthropometric measurements and specific karate precision, and X_2 - a statistically significant correlation is expected between the treated motor skills and specific karate precision, based on the obtained results, they are completely rejected.

Among juniors, there is no statistically significant prediction of anthropometric and motor variables as predictors related to criterion variables for assessing specific karate precision.

Regarding the null hypothesis stated in the study, which states X0 - no statistically significant predictive values are expected between the investigated spaces of the predictor system of variables (anthropometric measurements and motor abilities) on the criterion variables (specific karate precision), it is fully accepted.

Regarding the first two hypotheses set in the study, which state: X1 - a statistically significant correlation is expected between the treated anthropometric measurements and specific karate precision, and X2 - a statistically significant correlation is expected between the treated motor skills and specific karate precision, based on the obtained results, they are completely rejected.

Regarding the last two hypotheses set in the study, which state: X3 - statistically significant differences in the variables for assessing motor space are expected between the treated groups of karate practitioners (cadets and juniors), and X4 - statistically significant differences in the variables for assessing specific karate precision are expected between the treated groups of karate practitioners (cadets and juniors), it can be concluded that they are accepted.

1.9 RECOMMENDATIONS

Considering the age distribution of the respondents, the author believes it is necessary to note that PRECISION is perhaps one of the factors that have influenced the results, taking into account that they are in an age range characterized by "Storm in motor skills," followed by intensive development of their anthropological dimensions.

In future studies, it would be beneficial to include the opposite gender as well.

Conduct a comparative analysis between the two genders.

Expand the study by incorporating additional variables to achieve a more comprehensive exploration of the research space.

Utilize other multivariate methods to analyze other relationships concerning the anthropological status of karate.

The author hopes that the study will provide a solid foundation for the process of selecting and monitoring young and talented karate practitioners, considering that achieving outstanding results relies on a scientifically justified approach rather than an intuitive one.

PUBLICATIONS RELATED TO THE DOCTORAL THESIS

1. Ventsislav Nedev, Aljosa Nedev, Ivajlo Prokopov. Analysis of the elements of strikes, blocks and fighting stances of tekioko and hean karate katas for students, ISSN 1857 - 9620 (Print) ISSN 1857 - 8196 (Online)УДК: 796.853.26.015.134 Faculty of Education, Sport, and Health at the University "St. Cyril and Methodius" in Skopje, *Journal: "KONDIČIJA"*: (2022) бр.17 (Web of science)
2. Vencislav Nedev, Ivajlo Prokopov, Priciples in traditional karate and their aplication, ISSN 1857 - 9620 (Print) ISSN 1857 - 8196 (Online), УДК: 796.853.26 Faculty of Education, Sport, and Health at the University "St. Cyril and Methodius" in Skopje, *Journal: "KONDIČIJA"* (2022) бр.16 (Web of science)
3. Ventsislav Nedev, Aljosa Nedev, Evgeni Yordanov, FUKU-GO (Ideal discipline in traditional karate), ISSN 1857 - 9620 (Print) ISSN 1857 - 8196 (Online). *Journal: "KONDIČIJA"*: (Web of science)

DECLARATION OF ORIGINALITY/ AUTHORSHIP

I, the undersigned,

VENTSISLAV ATANAS NEDEV,

деклари hereby declare with my signature that my doctoral thesis titled "**THE IMPACT OF MOTOR SKILLS AND ANTHROPOMETRIC PARAMETERS ON THE ACHIEVEMENT OF SPECIFIC KARATE ACCURACY**" for the award of the doctoral degree is my original work, written and prepared by myself.

I declare that this doctoral thesis has not been submitted for publication or published under any other title. I declare that I am submitting my own original work and take full responsibility for the authorship of the dissertation.

The sources used have been accurately cited and referenced with proper acknowledgment of their authors. I am liable under the Copyright and Related Rights Act for any false declarations made.

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