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Original article

A Gender-Approach-Based Biomechanics of Junior Female Karate Athletes in Cienfuegos, Cuba

[*La biomecánica con enfoque de género en las karatecas pioneriles de Cienfuegos, Cuba*]

[*Biomecânica com uma abordagem de gênero nas mulheres pioneiras do karatê de Cienfuegos, Cuba*]

Ana Margarita Torres Águila[1*], *Juan Carlos Zamora Alambarrí*[1], *Omar Peña López*[1]

[1]*Carlos Rafael Rodríguez University of Cienfuegos, Cuba*

[*]Autor para la correspondencia: atorres@ucf.edu.cu

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ABSTRACT

Introduction: Biomechanics is one of the most demanding activities, when human movements are studied in sports, as the proper scenario to improve research skills with the comprehensive preparation of university students and society. In Cuba, research is done to implement changes in the existence of inequalities between men and women, as several studies deal with the gender approach in the sports context. **Aim**: To study the flexibility of junior female karate athletes in Cienfuegos, with a gender approach, to enhance student research skills as part of the scientific group of students at the Bachelor Degree of Physical Culture and Sports. **Methods**: This research study was conducted with a qualitative approach, using theoretical methods like the historical-logical and documentary analysis; the empirical method used was structured interview of female athletes engaged in combat sports. **Results**: This work showed an improvement in research skills. The students played a key role in the enhancement of kicking techniques, and greater flexibility of junior karate athletes in the study. **Conclusions**: The biomechanical analysis conducted by the members of the scientific group of students showed enhanced research skills in Sports Biomechanics.

Keywords: karate-do, gender, biomechanics, research skills, flexibility.

RESUMEN

Introducción: La Biomecánica asume una de las actividades de mayores exigencias en la carrera al estudiar el movimiento del hombre en el desempeño deportivo, escenario propicio elevar las habilidades investigativas mediante la preparación integral de los estudiantes universitarios y en la sociedad cubana investiga la vía adecuada para modificar de manera saludable la desigualdad entre hombres y mujeres y numerosas investigaciones tratan el enfoque de género en el contexto deportivo.
Objetivo: consiste en analizar la flexibilidad en las karatecas pioneriles de Cienfuegos con enfoque de género para desarrollar las habilidades investigativas de los estudiantes que integran el grupo científico estudiantil en la carrera Licenciatura de las Ciencias de la Cultura Física y el deporte.
Métodos: La investigación se desarrolla bajo en enfoque cualitativo, con los métodos teóricos que se utilizan son el histórico-lógico y el análisis de documentos y el método empírico entrevista estructurada a las mujeres de los deportes de combate.
Resultados: El trabajo con el grupo científico estudiantil logró un desarrollo en las habilidades investigativas, fueron protagonistas en el perfeccionamiento de la técnica de pateo y el desarrollo de la flexibilidad en las karatecas pioneriles seleccionadas.
Conclusiones: El análisis biomecánico realizado por los integrantes del grupo científico estudiantil evidencio enriquecimiento en las habilidades investigativas en la Biomecánica Deportiva.

Palabras clave: kárate-do, género, biomecánica, habilidades investigativas, flexibilidad.

RESUMO

Introdução: A biomecânica assume uma das atividades mais exigentes da carreira estudando o movimento do homem no desempenho esportivo, um cenário propício para elevar as habilidades de pesquisa através da preparação abrangente dos estudantes universitários e na sociedade cubana investiga a forma adequada para modificar de forma saudável a desigualdade entre homens e mulheres e inúmeras investigações tratam da abordagem de gênero no contexto esportivo.
Objetivo: analisar a flexibilidade dos karatecas pioneiros em Cienfuegos com uma abordagem de gênero, a fim de desenvolver as habilidades de pesquisa dos estudantes que compõem o grupo científico estudante do Bacharelado em Cultura Física e Ciências do Esporte.
Métodos: A pesquisa é desenvolvida sob uma abordagem qualitativa, sendo os métodos teóricos utilizados os históricos-lógicos e a análise de documentos e o método empírico entrevistas estruturadas com mulheres em esportes de combate.
Resultados: O trabalho com o grupo científico de estudantes alcançou um desenvolvimento nas habilidades de pesquisa, eles foram protagonistas no aperfeiçoamento da técnica de pontapé e no desenvolvimento da flexibilidade nos jogadores de karatê pioneiros selecionados.
Conclusões: A análise biomecânica realizada pelos membros do grupo científico estudantil evidenciou enriquecimento nas habilidades de pesquisa em Biomecânica Esportiva.

Palavras-chave: Karate-do, gênero, biomecânica, capacidade de pesquisa, flexibilidade.

INTRODUCTION

Cuban women have accomplished high sports results. In the twenty-first century, one of the most relevant Studies of the scientific community deals with women in health, education, and sports. This paper focuses on the conflicts of women in sports, particularly combat sports, at sports starting. That way, there is a considerable long-term increase in sports technique optimization and health in athletes. This contribution of applied sciences to sports are directed to the life quality of women who practice karate-do.

The benefits of this sport have been studied to maintain the athletes' life quality to a high standard. According to the 2030 Agenda for Development, of the United Nations Organization for the Education, Science and Culture (UN 2015), (UNESCO, 2017), some of the work strategies include sustainable development from education. Goal No. 3, for instance, it promotes a healthy life and the wellbeing of all at every age, whereas Goal No. 5 was conceived to achieve gender equality and empower women and children.

Merma, Gavilán, and Hernández (2021) studied the way in which gender equity is dealt with in the formation of new teachers, and the actions agreed to meet Goal No. 5 of the work strategies for sustainable development. The Cuban society studies the adequate forms of changing inequalities between men and women properly. Other researchers deal with gender approach in the context of sports, including León (2010); Duarte, Dos Santos, and Robert (2016); Dosal, Mejía, and Ortis (2017); Dosal *et al.* (2017); Duarte *et al.* (2017); Llorca *et al.* (2018), and Naranjo and Suárez (2020) noted that inequalities lead to a lower participation of women in major combat competitions, such as the Olympics.

There is a need to promote sports practice to improve the physical and mental health, as well as the life quality of people, particularly women, according to the International Olympic Committee. Hence, it is important to change the scope of women in society. It is the protection of women in favor of inclusion, eradicating prejudices that hinder the development of women in sports. It is a need of Latin American countries, which is also a priority for Cuba. Though there are certain taboos in families, the said goals are met in the Cuban case. Occasionally, the authorization of the family to girls has unfavorable settings when it comes to combat sports. The talent selection in these sports is sometimes blocked by the above prejudices. Karate-do practice helps develop the girls' mental and physical health. These regularities often take place due to the lack of information and student education. This paper deals with the continuous education of students with a gender perspective in higher education.

The bachelor degree of Physical Culture and Sports lacks proper research related to this topic. However, in the applied sciences, there is a constant exchange of ideas to address this issue in methodological scenarios. The discipline Sports Biomechanics undergoes substantial changes in relation to the gender-approach contents due to its repercussions in society. This study looks to ways of eradicating inequalities suffered by girls and women who practice a given sport.

Donskoi (1988) cited by Estrada (2018) and Torres (2021) said that biomechanics as an integrating science, studies the particularities of motricity, depending on sex and age. They also consider that Sports Biomechanics contributes to the study of human movement, through the evaluation of different sports characteristics, such as the study of complex reactions in combat sports. Therefore, it is important to understand athlete diversity to improve the sports technique and prevent injuries. Besides assessing the situation of women in sports practice, namely, judo, taekwondo, wrestling, and karate-do, there is a morpho-functional description of women, the benefits of women in karate-do.

Karate-do is a martial art that favors gender equality, so flexibility should be studied in junior female karate-do athletes in Cienfuegos. León (2010, p.92) said that women have biological characteristics that help develop flexibility in karate-do. The somatotype's features of women have advantages in this sport, since they are thinner, with narrower shoulders, a broader pelvis, greater laxity of connective tissues, and lower muscle hypertrophy, so flexibility is developed more easily. Moreover, women are fitter for motor coordination and greater dexterity in movement coordination, which is is a strength for kicking in karate-do.

Canel and García (2020), and Merma, Gavilán, and Hernández (2021) noted that university research is looking to transform the communities to promote people's health through science. This institution improves the system of science and innovation with clear ideas on gender inclusion. From this perspective, applied sciences in sports, particularly sports biomechanics, play a critical role in the development of research skills with a gender approach.

Moreno (2005) cited by Fernández, Carcausto y Quintana (2022) said that the research skills are the relationships between human skills and the development of experiences through science. Hence, the research skills are the results of scientific, technological, and teaching development. This research is a step to strengthen gender equality in combat sports. However, some studies based on the social paradigm rule out the participation of women in combat sports. Today, including women in combat sports and martial arts is a challenge.

Duarte, Dos Santos and Robert (2016); Dosal *et al.* (2017); Duarte *et al.* (2017); Llorca *et al.* (2018), and Naranjo and Suárez (2020) showed the need to change the paradigms, in order to strengthen women inclusion in sports. Nevertheless, women are ruled out from sports like karate-do, or they are not properly stimulated to stay in the sport. Accordingly, girls and teenagers lose motivation easily due to the lack of attention and knowledge. They lack a broad vision of the benefits offered by karate-do as a martial art. The previous has consequences on gender equality. This research lays the foundations to establish scientific groups in universities associated with the achievements of women in combat sports, which brings benefits to humans.

Research skills of student research groups. Challenges of applied sciences.

Higher education in the twenty-first century involves university students in the area of experimental sciences. The Bachelor Degree of Physical Culture and Sports promotes the inclusion of applied sciences in sports to articulate them directly in sports training, the search for solutions to meet the needs of athletes, and improve life quality.

The development of applied sciences based on scientific breakthroughs opens a door to sports training effectiveness. In keeping with the scientific setting, biomechanics develops and evolves.

In Cuba, the Bachelor Degree of Physical Education and Sports encourages students to acquire knowledge of biomechanics and put it into practice through biomechanical studies. However, they just go over essential contents due to fragmentation and absences of preceding basic subjects in high school, such as Physics, Chemistry, and Biology. Alongside these shortcomings, self-study is absent, with the ensuing absence of research skills.

Macedo (2016), Arias and Navarro (2017), and Asencio (2017) expressed that the research skills are hindered when education does not relate differences sciences with the proper direction. The sciences in several areas contribute to the logic of integrative knowledge. Problematic situations should be regularized in keeping with the social factors that take place and the students experiences so that they can achieve significant learning.

Estrada (2018) and Torres (2021) said that biomechanical science requires knowledge from a number of sciences. Their union ensures the strength of scientific knowledge on biomechanics. That paper unveiled the relevance of discipline Sports Biomechanics as an essential program for the Physical Culture and Sports graduates. The high school physical education teachers are in charge of providing the contents through the basic subjects in the curriculum, such as Physics, Biology, and other sciences. The essence of these sciences relies on logical, conceptual, and contextual knowledge. However, there are still shortcomings in terms of experimental studies. Hence, the expected learning results are still unmet.

The previous authors considered that among the formative objectives the improvement of research skills plays a major role. They are oriented through the work strategies of student scientific groups. To implement such setting, there must be overall mastery of the theoretical and practical knowledge based on science, which benefit society and contribute to quality education. Besides, new didactic proposals should be designed as tools to integrate knowledge into the applied sciences linked to sports, depending on gender equality, particularly sports biomechanics.

The application of sports biomechanics in combat sports with a gender approach.

Sports biomechanics in the Physical Culture and Sports Bachelor Degree promotes the relationship of this science with sports in developing stages. However, there are cognitive shortages in physics, chemistry, and biology, a weakness for biomechanical knowledge acquisition, and understanding this science. Saz (2016), Perdomo (2018), Puentes *et al.* (2018), Estrada (2018), Salom *et al.* (2019) and Valdés et al. (2020) claimed

that sports-related knowledge in applied sciences ensures content treatment in the search for gender equality as a social impact based on continuous education of the students.

Duarte, Dos Santos, and Robert (2016), and Dosal, Mejía, and Ortis (2017) considered that it was necessary to strengthen women's sports, which is indispensable to acquire healthy habits, and reduce the occurrence of chronic and degenerative diseases. Enhancing the potentialities of the sports context in both genders, and supporting women are needs that should be changed for the sake of humanity and sustainable development. Nevertheless, the needs and aspirations of women should be considered, depending on the selection of combat sports talents, which have been affected by the refusal of families. It harms the girls' minds and self-esteem.

Today, it is necessary to help meet the challenges posed to women, especially with their inclusion in combat sports since early ages, and to improve their life quality. Knowing the specific features of students in the scientific group are critical for research, since they are athletes interested in getting knowledge on combat sports, particularly karate-do.

Karate-do flexibility A study of sports biomechanics

Cuban sports institutions place a major interest in combat sports. But the presence of women in these sports has been a problem due to the stereotypes and prejudices they share. In this paper, the characterization of combat sports is determined, particularly karate-do, one of the martial arts. The physical flexibility capacity and the biological properties of women excitability help with the effectiveness of karate-do techniques.

Gómez (2010) and Torres (2021) said that flexibility is the capacity of the muscles to adapt to the existence of eccentric muscle work with an antagonistic function due to muscle elongation. Increased joint movement is acquired with the regularity of physical exercise. It is a morphological and functional property of the loco-motor apparatus. Flexibility helps kicking effectiveness in combat sports. The greater the capacity of stretching muscles, the greater the angle broadness for joint movements, with less energy efforts to achieve physical movement.

Gómez (2010) said that there is greater flexibility in the early stages. Besides, he considered that flexibility is important for karate-do, as its development permits to enhancing kicking techniques. It has a positive effect on quick movements, and the displacement of body movements will be more efficient the greater joint movement is. The transition of the biokinematic chain will have a broader angle. This physical condition integrated by the body, mind, and spirit, along with flexibility, agility, mobility, strength, and stability is established to increase athletes' life quality.

This research deals with the science applied to sports with emphasis on sports biomechanics. Hence, there is greater interest over information technologies (IT) with the biomechanical studies using Kinovea, simulators, and videos that analyze women's flexibility in combat sports, particularly in karate-do.

In this sense, the members of the students' scientific group of Biomechanics evaluated biomechanics software at the service of sports and the Cuban society. Simulation of combat sports movements. The impact of women on combat sports and gender quality in science. Using sports biomechanics to enhance technical work preparedness, achieve higher yields, and reduce the risk of sports-related injuries in women.

Interviews of active female karate athletes showed that in this sport, the usual chronic affections are observed in the lower limbs, such as the knees and ankles due to inadequate use of sports techniques and inappropriate warm-ups. Injury-prone joints should be strengthened. A factor of risk is the lack of understanding of sports biomechanics. Moreover, that suggests that the practice of combat sports should start at early ages, with improvements in flexibility, particularly in karate-do. That way, motor coordination is higher, with greater stability in kicking, and it is a guarantee to increase the life quality of female karate athletes.

The combat sports training plans were evaluated in karate-do to check gender equity. There was an absence of preparedness by the coaches to plan actions with gender inclusion. Furthermore, there was little psychological, pedagogic, and didactic treatment at early ages in the females. The male participation in these sports is by far, greater. The girls that enroll in this sport lose motivation and stop practicing due to the lack of attention by the coaches.

This issue was included in the empirical instruments comprising the last five years. It also includes documentary review, surveys of karate-2 teachers and coaches, and interviews of active female karate athletes. Additionally, exchanges with teachers of the applied sciences revealed the importance of determining the existing limitations in the technical preparedness of the athletes to implement gender inclusion.

- Limited exchanges among coaches with the professionals of applied sciences to enhance the life quality of active female karate-do athletes in Cienfuegos.
- Limited planning, managing, and conducting sports training to enhance women inclusion in combat sports.

In general, there are solutions to problems related to karate-do. However, there are shortcomings in the technical preparedness with a gender approach, which reveal the existence of injuries related to the sport in women, in Cienfuegos, due to the lack of sports biomechanics in terms of flexibility. Accordingly, the aim of this research is to study the flexibility of junior female karate athletes in Cienfuegos, with a gender approach, to enhance student research skills as part of the scientific group of students at the Bachelor Degree of Physical Culture and Sports.

MATERIALS AND METHODS

Several theoretical and empirical methods were used. Among the former, the historical-logical method was used to systematize the theoretical conceptions about sports biomechanics and the characteristics of karate-do, especially the junior karate-do athletes. Documentary analysis was used to analyze the training plans of the sport in

junior athletes, with a gender approach. Other documents related to sports biomechanics were studied to evaluate flexibility in combat sports, with a gender approach, to optimize sports techniques and prevent the risk of injuries. Besides, the efforts of student scientific groups to assist in the development of research skills with a gender approach.

The empirical methods were structured interview of women who practice combat sports, and as survey to the applied sciences specialists, which confirmed that sports biomechanics is an integrating science that promotes gender equality.

To achieve that goal, a sample of two junior karate-do athletes from the No 3 Sports Center in Cienfuegos, and another sample containing five students in the second year of the Physical Culture and Sports Bachelor Degree who belong to the scientific group, based on their interest in this research study. The research was based on a qualitative design, which helped analyze biomechanics according to improvements in flexibility of junior karate-do athletes, with a gender approach.

RESULTS AND DISCUSSION

This study deals with education in the area of STEA+M (Science-Technology-Engineering-Arts+Mathematics), with innovating solutions. Particularly, the gender approach constitutes an important line guiding the purposes of Project Hypathia at the Carlos Rafael Rodriguez University, in Cienfuegos. These results are part of Dimension 2 STEA+M Education with a gender perspective in professional education, including task Application of sports biomechanics in women's sports.

This research belongs to one of the work strategies at the Physical Culture Faculty, which prioritizes professional education, as part of the athlete's training and preparedness for research skills, conducted by student scientific groups. It is generalized in the second year of the degree, with clear improvements in the acquisition and development of research skills. The skill measurement results are shown in table 1 (Table 1) and (Table 2).

Table 1. *- Results of the evaluation of research skills in the students from the scientific group by goal*

Students	Goals met	Evaluation of skill development by goal
1	1-2	A
2	2-3	A
3	1-2-3	G
4	1-2-3	G
5	1-2-3-4	VG

Goals of the scientific group to measure research skills

1. To analyze several scientific papers focused on women inclusion in society.
2. To apply biomechanics science in favor of sports training in combat sports.
3. To use Kinovea software to analyze kicking flexibility in karate-do by the female junior athletes in Cienfuegos.
4. To design lower limb movement simulators to study injury-sensitive areas.

- If they meet two goals (A).
- If they meet three goals (G).
- If they meet four goals (VG).

Table 2. *- Results of research skills development in the scientific group*

Development of research skills	Qualitative measurement
Evaluated as *very good*	1
Evaluated as *good*	2
Evaluated as *average*	1
Evaluated as *bad*	0

The psychological, pedagogical, and didactic treatment given by the sceince group, produced the expected educational reality in the development of research skills with a gender approach. The use of Kinovea software to analyze kicking flexibility in karate-do by the female junior athletes in Cienfuegos was a significant step forward.

CONCLUSIONS

The biomechanical analysis conducted by the members of the scientific group of students showed IT-aided enhanced research skills in Sports Biomechanics.

The continuous work with the students' scientific group ensures inclusive education.

The kicking technique in combat sports was improved, and greater female athlete flexibility was achieved in the junior category.

The outcome of this research was presented and discussed at the student scientific meeting, with outstanding results, according to the scientific study of injury vulnerable areas, and as a way of contributing to higher life quality of female karate-do athletes.

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The authors have taken part in the redaction of the manuscript and analysis of the documents.