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ORIGINAL ARTICLE

Comparison of the physical fitness of children who train karate in the Joinville/SC region

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ABSTRACT

The study aimed to compare the physical fitness of children who train Karate in the region of Joinville, Santa Catarina. The study population consisted of ten children aged eight to 14 who participated in Karate training, 40% of whom were female. The physical fitness variables were: Body Mass Index and Body Adiposity Index; Upper Limb Strength, Lower Limb Strength, Flexibility and Localized Muscular Resistance. Student's t-test was used to compare between pre and post-test, considering $p < .05$ as significant. Significant differences were found only for Lower Limb Strength ($p = .03$; d = -0.56) and Localized Muscular Resistance ($p = .01$; d = -0.54), showing improvement in jumping and abdominal resistance. Although not significant, there was a decrease in body composition in the post-evaluation. In all physical tests there was an increase in the average, revealing that the children presented good performance in jumping and abdominal resistance.
Keywords: Health, Martial arts, Exercise test, Sport, Aerobic exercise.

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INTRODUCTION

Sport such as Karate, which involve improving physical fitness (Krkeljas & Kovac, 2020). Karate is a sport that requires strength, flexibility and Endurance, essential characteristics for good performance of technical movements and for improving physical health (Stamenković et al., 2022).

According to the Stamenković et al. (2022) systematic review, practicing martial arts, such as Karate, can be an excellent sport to improve children's physical fitness, and can be used during physical education classes. In this case, Karate is a sport that positively influences children's health, improving body composition by reducing the Body Mass Index (BMI) and Body Adiposity Index (BAI), as well as physical conditioning, with better results in strength, endurance and flexibility (Arslan et al., 2024; Krkeljas & Kovac, 2020; Stamenković et al., 2022).

Monitoring the physical fitness of children who practice sports is essential to understanding their qualities or improving them, aiming not only at good performance in training and competitions, but mainly for their health, positively influencing them in adulthood (Jesus et al., 2025; Nahas, 2017). This research aims to fill this gap, providing relevant information on the evolution of physical fitness of children practicing Karate in a little explored region.

Therefore, given this context, the study aimed to compare the physical fitness of children who train Karate in the region of Joinville, Santa Catarina.

METHOD AND MATERIALS

Research design

This is an applied study with a quantitative approach and descriptive character, considering a longitudinal study. Obtaining the participation, unicentric, of a gym in the city of Joinville. Therefore, the research was carried out with voluntary participants, aware of the confidentiality of the data. The children's guardians were aware of the research objectives and its purpose. Likewise, this study was in partnership with the Physical Activities Center (PAC) Extension Project of the University of the Joinville Region, thus having the favourable opinion of the Ethics Committee in Research with Human Beings of Univille, sub number 5.161.461.

Participants

The study population consisted of children aged eight to 14 who participated in Karate training (each session lasting 60 minutes) in 2023 at a gym located in Joinville, Santa Catarina, Brazil. The sample consisted of ten children, 40% of whom were female. For this, the inclusion criteria were children who had authorization from their guardians to participate and who performed all physical tests. On the other hand, participants who did not meet the inclusion criteria were excluded from the sample.

Measures

The physical fitness variables were the Medicine Ball Throw Test (2 kg) to measure Upper Limb Strength; Horizontal Jump Test to measure Lower Limb Strength, Sit and Reach Test to measure Flexibility, 1-minute sit-up test to measure Localized Muscular Resistance according to the Manual of the Projeto Esporte Brasil - PROESP-BR (Gaya et al., 2021). Finally, the body composition variables analysed were weight (kg), height (m) and hip circumference (cm) for the calculations of the Body Mass Index [BMI = weight/height^2] and Paediatric Body Adiposity Index [IACp = hip circumference/height^0.8-38]. For this, the materials used were: Tape measure (25 meters), Medicine Ball (2 kg), ruler (30 cm), stopwatch (minutes), mat; stadiometer (2

meters), digital scale (100g accuracy), Tape measure (3 meters).

Procedure

As a procedure, an initial meeting was held with the academy's coordinators, requesting authorization to carry out the collections. Those responsible also participated in a meeting to be aware of the research objectives, with the aim of authorizing the children to participate.

The tests were applied over two days (two consecutive Fridays) in the last week of October (2022). In the first week, flexibility and Lower Limb Strength and body composition were collected. In the last week, the Localized Muscular Resistance and Upper Limb Strength were collected. To conduct the measurements, three students and a physical education professional, familiar with the research protocols/instruments, were recruited. This same team evaluated for the second time in early March (2023), accounting five months.

To collect the anthropometric assessment, the children were asked to be barefoot. For the physical tests, they were asked to wear sneakers. First for the Horizontal Jump Test, asking them to jump forward as far as they could. For the 2kg Medicine Ball Throw Test, the child was instructed to throw the ball as far as they could. For Flexibility, were asked to sit on the floor and try to reach their toes with their arms extended and hands together. For the Localized Muscular Resistance, was asked to perform as many sit-ups as possible in 1 minute.

Statistical analysis

The data were analysed using R Studio software (v 4.1.1), showing normality by the Shapiro-Wilk test. In this sense, the results were analysed using descriptive statistics (mean and standard deviation) and absolute and relative frequency (%). In addition, Student's t-test (paired samples) was used to compare between pre and post-test. To assess the effect size, Cohen's D was calculated, considering the classification from "*small*" (<0.19) to "*very large*" (>1.30), with a 95% confidence interval (95% CI), considering $p < .05$ as significant.

RESULTS

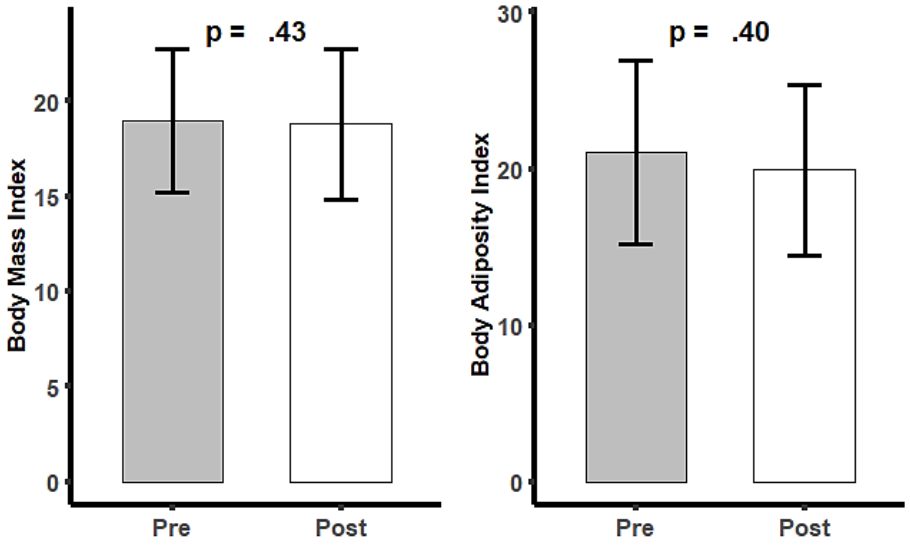
Ten children participated in the study, 40% of whom were female, aged 10.60 ± 2.27 years. Other information such as weight, height, Hip circumference (cm) and practice time are presented in Table 1.

Table 1. Sample characterization.

Variables	$\dot{x}$	SD
Age (years)	10.6	2.27
Weight (kg)	41.48	13.78
Height (m)	1.46	0.15
Hip circumference (cm)	80	11.9
Practice time (months)	41	22.76

Note. $\dot{x}$ = mean, SD = standard deviation. Source: own authorship (2025).

In Figure 1 it is possible to observe that there was a decrease in BMI [pre = 18.96 ± 3.78; post = 18.77 ± 3.96; d = 0.04] and BAI [pre = 21.03 ± 5.87; post = 19.92 ± 5.42; d = 0.19] in the post-evaluation, but without significance ($p = .4$).



Note. Source: own authorship (2025).

Figure 1. Body composition comparison.

For the physical tests, significant differences were found only for Lower Limb Strength (p = .03; d = -0.56) and Localized Muscular Resistance (p = .01; d = -0.54), showing improvement in jumping and abdominal resistance.

Table 2. Comparison (pre and post) of physical tests.

Physical tests	**Pre (n = 10)**	**Post (n = 10)**	**Δ**	***p***	**d (CI 95%)**
	Ẋ ± SD	Ẋ ± SD			
Lower limb strength	1.47 ± 0.24	1.62 ± 0.27	-0.2	**.03**	-0.56 (-1.07; -0.05)
Upper limb strength	2.10 ± 0.85	2.19 ± 0.80	-0.1	.22	-0.10 (-0.26; 0.06)
Localized muscular resistance	27.50 ± 11.74	33.70 ± 11.07	-6.2	**.01**	-0.54 (-0.88; -0.19)
Flexibility	43.40 ± 7.57	44.00 ± 8.78	-0.6	.73	-0.07 (-0.49; 0.34)

Note. Ẋ = mean, SD = standard deviation, n = sample number; Δ = mean difference, p = <.05 for significant, d = effect size; CI 95% = confidence interval. Source: own authorship (2025).

DISCUSSION

This study aimed to compare the physical fitness of children who train Karate in the region of Joinville, Santa Catarina. There was a decrease in body composition in the post-evaluation, but without significance. In the physical tests, there was also an increase, but significant differences were found only for Lower Limb Strength and Localized Muscular Resistance.

In the Lower Limb Strength and Localized Muscular Resistance test, there was a significant improvement, suggesting an improvement in jumping and explosive strength, as well as abdominal resistance. Lower limb strength and localized muscular endurance have an important relationship with the execution of certain movements in karate (Krkeljas & Kovac, 2020). Lower limb and abdominal exercises can improve performance in karate and are essential for effective technical execution (Krkeljas & Kovac, 2020).

For the Upper Limb Strength and Flexibility tests, there was an increase in the average, which could assume an improvement in physical performance, however the data were not significant. To improve upper limb strength, it is necessary to include strength training in Karate classes, taking into account the age groups and genders of the participants (Abuzayda, 2024). The results of Ivanović & Ivanović (2022) indicated that the perception of one's own flexibility had a statistically significant and positive contribution to predicting the variability of the participants' physical activity ($\beta = 0.037$; $p < .01$). This means that karatekas who believed they had greater flexibility tended to present higher levels of physical activity (Ivanović & Ivanović, 2022). In this context, it is up to teachers and parents to increase children's autonomous motivation, making them more self-determined and with greater self-efficacy (Gillison et al., 2017).

There was a decrease in BMI and BAI, which may indicate an improvement in body composition, but the results were not significant. Even so, karate is a sport that generates health benefits. A Karate training program (10 weeks) for children aged five to seven years (18 in the Karate group and 10 in the control group). The Karate group trained basic techniques (90 minutes, four times a week). In the comparison between groups, the Karate group presented a lower percentage of body fat in the post-test (Arslan et al., 2024). The Sun & Kim (2022) study analysed the effects of combat training on body composition in obese children and the results showed that body fat percentage and BMI decreased significantly in the training group after 12 weeks ($p < .001$). In this case, combat sports can decrease the inflammatory response and improve metabolic health (Sun & Kim, 2022).

The limitations of the study are the low sample size, as well as the location of the intervention, which determined only one gym in the Joinville region, making it difficult to extrapolate the data. However, these points should be seen as an opportunity for a new scientific research challenge, since the analysis of children's physical fitness is necessary in the contemporary times in which we live.

CONCLUSION

When comparing the physical fitness of children practicing Karate in the region of Joinville, Santa Catarina, it was possible to find better values in the post-test. Although not significant, there was a decrease in body composition in the post-evaluation. In all physical tests there was an increase in the average, however significant differences were found only for Lower Limb Strength and Localized Muscular Resistance, revealing that the children presented good performance in jumping and abdominal resistance. It is recommended that these instruments be applied to several other children who play sports, in order to create effective strategies for taking care of children's health and physical performance.

AUTHOR CONTRIBUTIONS

Author EEDJ collected and analysed the data and wrote the manuscript. Author DLC designed the methodology and collected the data. Author PJCM supervised and revised the content.

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No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

DATA AVAILABILITY

The data used in this study are available upon request to the corresponding author.

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SUSTAINABILITY & SPORTS SCIENCE JOURNAL

ORIGINAL ARTICLE

Relationship between anthropometric values and physical fitness in children and adolescents

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ABSTRACT

The aim of this study was to analyse the relationship between anthropometric variables and physical fitness in children and adolescents, assessing the impact of Body Mass Index (BMI), Waist to Hip Ratio (WHR) and Waist to Height Ratio (WHtR) on motor performance. This was a descriptive, cross-sectional study of 455 children and adolescents (92 girls and 363 boys) aged between 6 and 17, enrolled at the Sports Initiation Center (NIES) in Canaã dos Carajás-PA. Anthropometric measurements were taken and flexibility, strength, aerobic endurance, speed and agility tests were applied. The results indicated that a higher BMI was negatively correlated with aerobic endurance and positively associated with upper limb explosive strength and flexibility. WHR was negatively correlated with flexibility and lower limb explosive strength, especially among girls. WHtR had the most significant correlations, negatively impacting cardiorespiratory endurance and muscle strength, but showing a positive association with agility and speed. We conclude that body composition significantly influences physical fitness, highlighting the importance of monitoring anthropometric indicators in childhood and adolescence to promote health and motor performance.

Keywords: Sport health, Body composition, Physical education, Physical fitness, Anthropometry.

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INTRODUCTION

Assessing the factors that influence physical fitness in children and adolescents has been a subject of growing interest in the health and sports sciences. Body composition, expressed by anthropometric measures such as Body Mass Index (BMI), Waist to Hip Ratio (WHR) and Waist to Height Ratio (WHtR), has been widely studied in relation to different components of physical fitness, such as strength, flexibility, cardiorespiratory endurance and agility. Understanding these interactions is fundamental to formulating strategies aimed at promoting health and motor development in childhood and adolescence.

Several studies have shown that a higher BMI tends to be negatively associated with physical performance in children and adolescents. Dumith et al. (2010) and Dumith et al. (2012) point out that individuals with high BMI levels have lower cardiorespiratory fitness, which is reflected in poorer performance in aerobic endurance tests, such as the 6-minute run and the 20-meter shuttle test. In addition, Mendoza-Muñoz et al. (2020) and Petrovics et al. (2020) point out that the relationship between BMI and physical fitness can follow a U-shaped pattern, indicating that both underweight and overweight or obese children can present physical limitations. Lourenço et al. (2023) emphasize that WHR also plays an important role in physical fitness, being negatively associated with agility and speed in children and adolescents.

The relevance of this study lies in the need to better understand how different anthropometric indicators influence the physical fitness of children and adolescents, allowing for more effective interventions to prevent health problems such as obesity and a sedentary lifestyle. By identifying the correlations between body composition and physical performance, this study can support educational programs and public policies aimed at promoting physical activity and improving the quality of life of this population. The main objective of this study is to analyze the relationship between anthropometric values and physical fitness in children and adolescents.

METHOD AND MATERIALS

Research design

This study adopts a descriptive and cross-sectional methodological approach, which, according to Hochman et al. (2005), consists of collecting data at a single point in time, allowing the prevalence of certain characteristics to be analysed in a specific population. This type of study is widely used to assess associations between anthropometric variables and physical fitness, providing a comprehensive view of the physical condition of children and adolescents at a given time (Bastos; Duquia, 2007).

With regard to ethical issues, the research was conducted in accordance with the principles of the Declaration of Helsinki for studies with human beings and followed the guidelines of the National Health Council for research involving minors. Before data collection began, a meeting was held with the participants' parents and guardians to present the objectives of the research, its relevance and the methodological procedures. The research was previously approved by a Research Ethics Committee, ensuring compliance with all ethical guidelines for studies with children and adolescents.

Participants

The sample consisted of 455 children and adolescents, 92 girls and 363 boys aged between 6 and 17, living in Canaã dos Carajás - PA, and enrolled in the Sports Initiation Center (NIES), a social project offered by the Municipal Foundation for Culture, Sport and Leisure - FUNCEL. The NIES covers various sports, such as

futsal, society soccer, volleyball, basketball, karate, muay-thai, judo and jiu-jitsu, providing a suitable environment for analysing the relationship between anthropometric variables and physical fitness.

The inclusion criteria adopted were: to be a student regularly enrolled at NIES and attending classes regularly; to be in the stipulated age group (6 to 17 years); and to have the consent of those responsible to take part in the research. Students were excluded from the study if: they were absent at the time of the assessments; they reported pain or showed signs of injury during the tests, which could compromise the validity of the results; and they did not obtain the consent of their parents or guardians to take part.

Measures

To ensure accurate and reliable data collection, standardized instruments validated in scientific literature were used, following the protocols established by the Brazil Sports Project (PROESP-Br), as described by Reis Gaya et al. (2021). The anthropometric assessment included the measurement of body weight, measured using a digital scale accurate to 100g, and height, measured using a portable stadiometer, guaranteeing a reliable assessment of the participants' growth. Wingspan was measured using a tape measure fixed to the wall, while waist and hip circumferences were obtained using a flexible tape measure, following internationally standardized protocols.

Physical fitness was assessed using specific motor tests. Flexibility was measured using the sit and reach test, which assesses the range of movement of the posterior chain. The explosive strength of the lower limbs was determined by the horizontal jump, while the explosive strength of the upper limbs was measured by throwing a 2 kg medicine ball. Localized muscular endurance was assessed using the 1-minute sit-up test, and cardiorespiratory fitness was estimated using the 6-minute run test, a protocol widely used to assess the aerobic capacity of children and adolescents. Agility and speed were analysed using a rapid displacement test with a change in direction, allowing the response time and motor efficiency of the participants to be verified.

Procedure

Data collection took place in a controlled environment, within the NIES sports facilities, over a period of four weeks. Initially, meetings were organized with those responsible to present the objectives of the study and clarify any doubts. After this stage, the participants underwent an initial screening, in which their health conditions and eligibility to take part in the study were checked.

The assessments were carried out on two separate days, with a 48-hour interval between sessions to avoid excessive fatigue. On the first day, anthropometric measurements were taken, including weight, height, wingspan and body circumferences, following the PROESP-Br recommendations. Each measurement was taken three times and the average of the values obtained was taken for greater precision.

On the second day, the participants underwent the physical tests, which were carried out by a trained team made up of physical education professionals and trained volunteers. Before the tests, a standardized warm-up was carried out, consisting of joint mobility exercises and dynamic stretches. Each test was then explained and demonstrated in detail to ensure the correct execution of the movements. Participants were given a chance to familiarize themselves before the test was officially carried out, minimizing possible execution errors.

By adopting a rigorous and standardized methodology, this study ensures the validity and reliability of the data, providing relevant information for understanding the relationship between body composition and physical fitness in children and adolescents.

Statistical analysis

The results obtained were recorded manually on individual spreadsheets and then entered into a Microsoft Excel for Windows database and analysed using the R Studio software (v 4.1.1). For the statistical analysis, descriptive statistics were used, with measures of central tendency (mean) and dispersion (standard deviation), as well as minimum and maximum values, allowing for a detailed characterization of the sample. In addition, Spearman's test was used to identify associations between the physical fitness and anthropometric variables, considering the correlations as: weak (0.10-0.39); moderate (0.40-0.69); strong (0.70-0.89); and very strong (0.90-1.00), considering the *p*-value <.05 as significant.

RESULTS

The study sample consisted of 455 children and adolescents, 92 females (20%) and 363 males (80%), aged between 6 and 17 years. The median age was 12 years for females and 10 years for males (Table 1).

Table 1. Characterization of the sample.

Variables	Female (n = 92)			Male (n = 363)		
	Min.	Median	Max.	Min.	Median	Max.
Age (years)	6	12	17	6	10	17
Weight (kg)	17.7	45.9	82.4	17.5	37.3	101
Height (m)	1.11	1.54	1.68	1.11	1.44	1.83
Wingspan (cm)	1.09	1.59	1.87	1.10	1.45	1.99
Waist (cm)	0.48	0.65	0.89	0.50	0.62	0.96
Hip (cm)	0.59	0.86	1.14	0.51	0.76	1.13

The mean values of the anthropometric variables differed between the sexes. In females, the median weight was 45.9 kg, height was 1.54 m, wingspan was 1.59 m, waist circumference was 0.65 m and hip circumference was 0.86 m. In males, the median weight was 37.3 kg, height 1.44 m, wingspan 1.45 m, waist circumference 0.62 m and hip circumference 0.76 m (Table 1).

The statistical analysis showed associations between the anthropometric variables and the physical tests carried out by the participants. Among the girls, BMI was correlated with flexibility and upper limb explosive strength, while WHR was correlated with flexibility and lower limb explosive strength. WHtR, in turn, was associated with the 6-minute run, abdominal endurance and agility (Table 2).

In the male group, BMI was also related to flexibility and upper limb explosive strength. WHR was associated with different physical fitness parameters, including flexibility, upper limb explosive strength, speed and lower limb explosive strength. WHtR was correlated with the 6-minute run, abdominal endurance, speed, lower limb explosive strength and agility (Table 2).

The results show variations in the associations between the different anthropometric components and physical fitness in children and adolescents, highlighting distinctions between the sexes in the relationships identified.

Table 2. Associations between variables.

Variables	Female (n = 92)			Male (n = 363)		
	BMI	**WHR**	**WHtR**	**BMI**	**WHR**	**WHtR**
Flexibility (cm)	0.21*	-0.26*		0.12*	-0.12*	
Racing (6 min.)	-0.38*		-0.40*		-0.30**	-0.51**
Abdominal (1 min)		-0.41*			-0.22**	-0.28**
Explosive force MMSS	0.61**			0.53**	-0.36**	
Speed (seg)						
Explosive force MMII		-0.43*		0.16*	-0.33**	-0.30**
Agility (seg)			0.28*		0.26**	0.23**

*Note: *p < .05; **p < .00*

DISCUSSION

The aim of this study was to analyse the relationship between anthropometric values and physical fitness in children and adolescents, identifying how different body measurements influence motor performance. The main findings revealed significant correlations between BMI, WHR and WHtR with various components of physical fitness, with significant differences between the sexes.

The results showed that Body Mass Index (BMI) had both a positive and negative correlation with different physical fitness variables. In girls, a higher BMI was positively associated with flexibility (0.21)* and upper limb explosive strength (0.61)*, which suggests that, to a certain extent, a higher body mass can favour these physical abilities (Table 2). However, a negative correlation was also observed with the 6-minute run (-0.38), indicating an adverse impact on aerobic endurance. These findings corroborate the studies by Dumith et al. (2010, 2012), who point out that increased BMI tends to impair cardiorespiratory fitness due to the greater energy expenditure required for locomotion.

Similar patterns were found in the male group. BMI showed positive correlations with flexibility (0.12)* and upper limb explosive strength (0.53), but negative correlations with the 6-minute run (-0.30), reinforcing the fact that excess weight can impair aerobic endurance while favouring strength (Table 2). These results are also compatible with the literature, which points out that BMI can be a predictor of worse aerobic performance, but without necessarily compromising muscle strength (Mendoza-Muñoz et al., 2020; Petrovics et al., 2020).

Waist-to-hip ratio (WHR) showed negative correlations with various physical fitness components. In girls, a higher WHR was negatively associated with flexibility (-0.26)* and lower limb explosive strength (-0.43)*, suggesting that greater central adiposity can compromise lower limb mobility and power (Table 2). Studies such as those by Buchan et al. (2012) and Lourenço et al. (2023) show that the accumulation of fat in the abdominal region can limit joint mobility and impair performance in activities that require coordination and explosive strength.

In boys, WHR also showed negative associations, affecting flexibility (-0.12), upper limb explosive strength (-0.36), speed (-0.33)* and lower limb explosive strength (-0.30)** (Table 2). These findings reinforce the idea that body fat distribution, rather than total weight, can be a determining factor in motor performance, especially in activities that require rapid movement and muscle explosion.

Waist-to-height ratio (WHtR) showed the most significant correlations with physical fitness variables, especially in the male group. In boys, a higher WHtR was negatively associated with the 6-minute run (-0.51),

1-minute sit-ups (-0.28), speed (-0.30)** and lower limb explosive strength (-0.30)** (Table 2). These findings are compatible with studies such as those by Ortiz-Sanchez et al. (2022), which indicate that a greater accumulation of abdominal fat may be related to lower cardiorespiratory and muscular performance due to increased resistance to movement and structural overload.

However, a higher WHR was found to be positively correlated with agility (0.26)** and speed (0.23**)**, suggesting that, despite cardiorespiratory and muscular limitations, some individuals with a higher WHR may perform better in rapid change of direction tasks (Table 2). This relationship may be associated with individual biomechanical and structural factors but requires further investigation.

Limitations

Despite the relevant findings, some limitations should be considered. Firstly, this study was cross-sectional, which prevents the determination of causal relationships between anthropometric indicators and physical performance. Longitudinal studies could provide a more precise understanding of how these associations evolve over time.

In addition, the sample was made up of children and adolescents involved in a sports initiation program, which may represent a population with levels of physical activity above the average for the general population. This characteristic may influence the results, making them less representative of sedentary children and adolescents. Future studies should include more diverse samples to broaden the applicability of the findings.

Another point to consider is that BMI, despite being a widely used indicator, has limitations as it does not differentiate between muscle mass and body fat. The inclusion of more precise methods, such as bioimpedance or skinfold assessment, could provide a more detailed analysis of the participants' body composition and its real influence on physical fitness.

CONCLUSION

By analysing the relationship between anthropometric values and physical fitness in children and adolescents, this study confirmed that different anthropometric indicators have a significant influence on the physical performance of the participants, thus achieving the proposed objective.

The main findings showed that BMI was negatively correlated with aerobic endurance but was positively associated with upper limb explosive strength and flexibility. WHR was negatively correlated with flexibility and lower limb explosive strength, especially in females. WHtR showed the most significant negative correlations, negatively affecting the 6-minute run, abdominals and lower limb explosive strength, especially in males. However, positive associations were also observed between WHtR and agility, suggesting that its influence on physical performance may vary according to the activity analysed.

These findings reinforce the importance of monitoring body composition in childhood and adolescence, highlighting the need for strategies that promote the maintenance of an adequate weight and regular physical activity. Future studies, including longitudinal analyses and more precise body assessment methods, may contribute to a more in-depth understanding of the relationships between anthropometric variables and physical fitness throughout child and adolescent development.

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No potential conflict of interest was reported by the author.

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Written informed consent has been obtained from the participants and legal guardians to conduct and publish this study.

DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author.

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SUSTAINABILITY & SPORTS SCIENCE JOURNAL

ORIGINAL ARTICLE

The emotional intelligence level and its relation with problem-solving for a sample of students at the institute of sciences and techniques of physical and sport activities at the University of Biskra

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ABSTRACT

This study aims at determining the level of emotional intelligence and of the ability to solve problems, and their relation for a sample of students at ISTPSA at the University of Biskra. The authors used the correlational descriptive and the comparative descriptive methods. In addition, they applied emotional intelligence and problem-solving scales on a simple sample of sixty-four students. Findings show that the informants' emotional intelligence is low unlike the problem-solving skills that are high. Besides, there is an average positive statistical relation between emotional intelligence and problem-solving. Finally, there are no statistically significant differences regarding emotional intelligence and the problem solving due to the educational level.

Keywords: Sport health, Emotional intelligence, Problem-solving, Correlational descriptive method, University students, Educational level.

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INTRODUCTION

The modern life is complicated and involves lot of problems due to the fast changes in the social, economic, political, and technological fields. This pushes the human to worry about how to face problems and adapt with the life circumstances with no harm to his mental, psychological, and physical health. In this regard, the ability to solve problems is crucial now. It does not require huge amount of information as much as it requires knowledge about how to employ information (Mohamed, 2009, p. 109). Acquiring this skill highly depends on our reactions towards the problem and on feeling its negative effects, what pushes us to take the decision of facing the problem to end its negative effects and reach balance.

The modern educational approaches adopt problem-solving methods to train students on facing the problems regardless their complexity and vagueness, using the mental and emotional skills together. In this regard, the traditional vision states that the high level of mental intelligence allows finding solutions to life problems. However, this premise was refuted by the modern studies on the emotional intelligence, as scholars noticed that the mental intelligence is, despite its positive effect on the academic achievement, not enough for success in the different life situations because we find academically successful people with difficulties in adapting with life problems and needs(Khidr, 2009, p. 14).

The psychological state helps overcome problems because the over-anxiety, depression, and haste deconcentrate the human and disorient his ability to solve the problem (Benzine, 2013, p. 68) In addition, the readiness, the mental state, and the motivation contribute to problem-solving, as they foster the suitable response and mobilize the previous knowledge and experiences. The emotional intelligence is key for success in life, since it helps understand the self-emotions and the others' to better direct the thinking and behavior. It is one of the factors that help achieve the psychological and life balance, as people with emotional intelligence target going along well with themselves and with the others, and set other goals in life (Meshakba, 2014, p. 85).

The university life is an interactive environment with different characteristics; therefore, it requires students to show emotional intelligence and problem-solving skills to adapt with the circumstances and challenges and gain experience, confidence, and ability to build successful relations. Based on what was said, we shall study these two variables for the students of ISTPSA at the University of Biskra. In so doing, some questions arise, as follows:

- What is the emotional intelligence level of the students of ISTPSA at the University of Biskra?
- What is the problem-solving level of the students of ISTPSA at the University of Biskra?
- Are there statistically significant differences regarding the emotional intelligence level due to the educational level for of the students of ISTPSA at the University of Biskra?
- Are there statistically significant differences regarding the problem-solving skills due to the educational level for the students of ISTPSA at the University of Biskra?
- Is there a statistically significant relation between the emotional intelligence and the problem-solving for the students of ISTPSA at the University of Biskra?

Study hypotheses

- The emotional intelligence level of the students of ISTPSA at the University of Biskra is low.
- The problem-solving level of the students of ISTPSA at the University of Biskra is high.
- There are no statistically significant differences regarding the emotional intelligence level due to the educational level for the students of ISTPSA at the University of Biskra.

- There are no statistically significant differences regarding the problem-solving skills due to the educational level for the students of ISTPSA at the University of Biskra.
- There is a statistically significant relation between emotional intelligence and problem-solving for the students of ISTPSA at the University of Biskra.

Importance of studying

Since the human is one unit made up of mental, psychological, and physical inseparable systems, the positive psychological aspects, including the motivation, excitement, reassurance, and emotional steadiness, and the mental aspects including the intelligence, thinking abilities, comprehension, and cognition make the individual in harmony with himself and the others. In this regard, he can achieve success based on emotional intelligence experiences and problem-solving using rationality, motivation, emotional steadiness, and efficiency, regardless of the complexity of the problem.

Identifying the concepts and terms

Definition of emotional intelligence

It is the ability to pay attention and understand, formulate, and organize the self-emotions and feelings based on an exact understanding of the others' emotions and feelings to build positive social emotional relations that help achieve mental, emotional, and professional development, and learn more positive life skills (Sayed & Rizk, 2002, p. 256). Besides, Goleman defines it as a set of different capacities for success in the different life aspects. He adds that the capacities can be learned and improved, and include the emotional knowledge, the emotions management, the excitement, the perseverance, the self-motivation, and perceiving the others' emotions, and managing the social relations (Said, 2008, p. 11).

The procedural definition of emotional intelligence

It is the awareness about self-emotions and the others' emotions, and the ability to build successful social relations.

Definition of the problem-solving ability

(Al Adl & Abd al Wahab, 2003)define it as the capacity to derive results from given introductions, and says it is the performance where the individual advances towards the known facts to reach the target unknown facts through understanding the causes and factors of the problems we solve (Al Adl & Abd al Wahab, 2003, p. 198). In addition, (Al Zaghloul & Al Zaghloul, 2003)see that it is a state the person seeks to reach goals that are not easily reached due to the unclear method of solving, the difficulty of identifying the methods of achieving the goal, the obstacles that hinder reaching the solution, or due to the use of thinking and mental abilities to perform mental tasks and get out of a situation (Al Zaghloul & Al Zaghloul, 2003, p. 16)

The procedural definition of problem-solving ability

It is using the mental thinking to solve a complicated and unknown problem we face, by relying on the subjective abilities, knowledge, and previous experiences to understand the problem, analyze its factors, perceive the solution, take the decision through choosing one of the potential alternatives, and then make the evaluation.

Literature review

Many studies tackled emotional intelligence and the problem-solving capacity, and others focused on their correlation, as we shall show.

The study of (Hitama & Ammour, 2021): It aims at examining the relation between the emotional intelligence and the achievement motivation, and the differences between the two genders regarding the degrees of emotional intelligence and achievement motivation. The sample included 156 male and female students from the University of Mouloud Maameri in Tizi Ouzou. The authors used the correlational descriptive method, relying of the emotional intelligence scale made by Abd al Moniim al Derir (2012) and the achievement motivation scale made by Abd al Razak Salah al Ghamidi (2009). Findings show a statistically significant correlation between the emotional intelligence and the achievement motivation, statistically significant differences regarding the degrees of emotional intelligence on behalf of the females, and no statistically significant differences between the two genders regarding the achievement motivation.

The study of (Yahi & Khelaifia, 2020): It aimed at knowing the level of emotional intelligence for the 3rd year secondary school students through revealing the relation between the emotional intelligence and the academic achievement. The authors used the descriptive method and applied the emotional intelligence scale made by (Sayed & Rizk, 2002)&(Abd al Hadi, 2003)after adapting it to the Algerian environment. In addition, they relied on the students' grades in the exams to estimate their academic achievement. The sample included 120 male and female students from a population of 380 students at the secondary school of Cherif Messaadia in Msilain 2016-2017. Findings show that the emotional intelligence level is high, there is no statistically significant relation between emotional intelligence and academic achievement, and there is statistically significant difference regarding the emotional intelligence between the students with high and low academic achievement on behalf of the students with a high intelligence.

The study of (Kaddouri & Dhebihi, 2016): It aimed at knowing the correlation between the emotional intelligence and the problem-solving ability for the secondary school students. The authors used the correlational descriptive method and applied the emotional intelligence scale made by Othman & Rizk (1998) and the problem-solving list of Hebner & Peterson, which was translated by al Samadi (1992). The sample included 131 male and female students from the secondary schools of Houari Boumedien and Barhoum al Jadida in 2013/2014. Findings show a statistically significant relation at .01 between the dimensions of emotional intelligence (self-awareness, self-regulation, motivation, empathy, and social skills) and the ability of problem solving. In addition, it found a statistically significant relation at .05 between the dimensions of social communication and the problem-solving ability.

The study of (Asfour & Ibrahim, 2015): It aimed at knowing the ability of complex problem solving for the university students. The authors used the descriptive method and applied London Tower test on a sample of two hundred male and female students at the University of Baghdad (al Jadiria Campus). After data collection and procession, findings showed that the informants have the ability to solve complex problems.

The study of (Saada, 2015): It aimed at revealing the nature of the relation between the emotional intelligence and the educational leadership ability of the schools' principals. The authors used the correlational descriptive method. For data collection, they chose the test of the ability of the educational leadership of Dr. Mohamed Mounir Morsi and the Emotional Competence Inventory ECI V2 of Goleman & Boyatzis. The sample included 180 principals of primary, middle, and secondary schools. Findings show that it is possible to forecast the educational leadership ability after knowing the emotional intelligence level. Besides, there were no differences regarding emotional intelligence due to the gender. Finally, the emotional intelligence level differs due to the seniority and the educational cycle.

The study of (Meshakba, 2014): It aimed at knowing the differences in the emotional intelligence of the Northern Borders University in KSA that can be attributed to the major (human/scientific), and the differences

in the emotional intelligence due to the educational level (1st year/ 4th year). In addition, the study investigated the relation between emotional intelligence and the ability to take decisions. The authors used a descriptive method based on emotional intelligence and the decision-taking scales. The sample included 216 students from Northern Borders University in KSA. Findings showed statistically significant differences in emotional intelligence due to the major on behalf of the human majors. In addition, there were no statistically significant differences due to the educational level. Finally, the study revealed statistically significant differences between emotional intelligence and decision-taking.

The study of (Al Harahecha, 2013): It aimed at knowing the degree of emotional intelligence for the headmasters of schools in the province of al Mafrag in Jordan from the perspective of the teachers. Besides, it investigated the effect of the social type, the scientific qualification, and the years of experience on the informants' responses. The author used the comparative descriptive method and a questionnaire of fifty-eight items with 05 axes, namely managing emotions, empathy, self-regulation, self-awareness, and the social skills. The sample included 223 male and female teachers. Findings show high emotional intelligence and no statistically significant differences due to experience, social type, and scientific qualification.

The study of (Saada Rachid, 2012): It aimed at revealing the nature of the relation between the emotional intelligence and the ability to manage the professional stress by the school's headmasters. The author used the correlational descriptive method, ECI V2 of Goleman & Boyatzis, and the professional stress scale made by the same author. The sample included 180 principals of primary, middle, and secondary schools. Findings showed it is possible to forecast the principals' level of managing and facing stress after knowing their emotional intelligence levels.

METHODOLOGY

Study population and sample

The study covers 205 students of ISTPSA at the University of Mohamed Khider in Biskra, from which sixty-four students (males and females) from three cycles (bachelor, Master, PhD) were chosen as a sample.

Method of the study

The authors used the correlational descriptive and comparative descriptive methods because they suit the nature of the study.

Study tools

Based on the previous relevant studies, we used the emotional intelligence 5-points scale of sixteen items, translated by Hassan al Maleh, and the problem-solving 4-point scale of forty items with 05 axes (general orientation, definition of the problem, generating alternatives, taking decision, and evaluation).

Table 1. Classification of the emotional intelligence levels.

Degrees of emotional intelligence	Estimations of emotional intelligence
50-70	Very low
70-85	Low
85-115	Average
115-130	High
130-150	Very high

Note. Classification of the levels of the problem-solving scale: 40-80: lack of problem-solving skills. +80: competent in problem-solving.

The psychometric properties of the study tools

Consistency

Table 2. The consistency of the problem-solving scale using the split-half.

Reliability statistics			
Cronbach's Alpha	Part 1	Value	.695
		N of Items	20[a]
	Part 2	Value	.785
		N of Items	20[b]
	Total N of Items		40
Correlation Between Forms			.711
Spearman-Brown Coefficient	Equal Length		.831
	Unequal Length		.831
Guttman Split-Half Coefficient			.824

Note. Source: Prepared by the researchers.

Table 2 shows a correlation between the even and odd items with a value of .711. In addition, Guttman equation shows an acceptable value of consistency of .831.

Table 3. The consistency of the emotional intelligence scale using the split-half.

Reliability statistics			
Cronbach's Alpha	Part 1	Value	.695
		N of Items	20[a]
	Part 2	Value	.785
		N of Items	20[b]
	Total N of Items		40
Correlation Between Forms			.711
Spearman-Brown Coefficient	Equal Length		.831
	Unequal Length		.831
Guttman Split-Half Coefficient			.824

a. The items are: qq1, qq3, qq5, qq7, qq9, qq11, qq13, qq15.
b. The items are: qq2, qq4, qq6, qq8, qq10, qq12, qq14, qq16.

Note. Source: Prepared by the researchers.

Table 3 shows a correlation between the even and odd items with a value of .788. In addition, Guttman equation shows an acceptable value of consistency of .882.

The discriminate validity

Table 4. The discriminate validity of the problem-solving scale.

Group statistics					
	VAR00002	N	Mean	Std. Deviation	Std. Error Mean
VAR00001	Min	10	95.3000	4.29599	1.35851
	Max	10	135.9000	2.76687	.87496

Independent samples test					
Levene's test for equality of variances					
Sig. (2-tailed)	df	t	Sig.	F	
.000	18	-25.125	.073	3.638	Equal variances assumed
.000	15.370	-25.125			Equal variances not assumed

Note. Source: Prepared by the researchers.

Table 4 shows that the arithmetic mean of the minimum values is 95.30 while of the maximum values is 135.9. As for the significance of the difference to compare the two means using T Student test, the calculated value is -25.125, which is statistically significant at significance level .000. Thus, there are statistically significant differences between the means of the minimum and of the maximum values, and the problem-solving scale has a discriminate validity.

Table 5. The discriminate validity of the emotional intelligence scale.

Group statistics					
	VAR00004	N	Mean	Std. Deviation	Std. Error Mean
VAR00003	Min	10	48.0000	12.18378	3.85285
	max	10	115.4000	8.48790	2.68411

Independent samples test					
Levene's test for equality of variances					
Sig. (2-tailed)	df	t	Sig.	F	
.000	18	-14.354	0.258	1.363	Equal variances assumed
.000	16.071	-14.354			Equal variances not assumed

Note. Source: Prepared by the researchers.

Table 5 shows that the arithmetic mean of the minimum values is forty-eight while of the maximum values is 115.4. As for the significance of difference to compare the two means using T Student test, the calculated value is -14.354, which is statistically significant at significance level .000. Thus, there are statistically significant differences between the means of the minimum and of the maximum values, and the emotional intelligence scale has a discriminate validity.

RESULTS

Presentation and analysis of the results of the first sub-hypothesis

It states that the emotional intelligence level of the students of ISTPSA at the University of Biskra is low.

Table 6. The arithmetic mean, standard deviation, and the emotional intelligence level of the informants.

Variable	**Mean**	**Standard deviation**	**Level**
Emotional intelligence (over all degree)	83.28	22.53	Low

Note. Source: Prepared by the researchers.

Table 6 shows that the arithmetic meant the overall degree of the emotional intelligence scale is 83.28 and the standard deviation is 22.53. In comparison with the approved emotional intelligence levels, this value is low. Thus, the informants have a low emotional intelligence, and the sub-hypothesis is confirmed.

Presentation and analysis of the results of the second sub-hypothesis

Table 7. The arithmetic means and standard deviation of the problem-solving scale and its axes.

Axes	**Arithmetic mean**	**Standard deviation**	**Level**
General orientation	22.95	3.35	High
Definition of the problem	24.32	3.44	High
Generating alternatives	22.54	3.36	High
Taking decision	24.5	3.26	High
Evaluation	21.68	3.71	High
The overall degree	116.01	14.04	High

Note. Source: Prepared by the researchers.

It states that the problem-solving level of the students of ISTPSA at the University of Biskra is high.

Table 7 shows that the arithmetic means of the problem-solving scale are between 21.68 and 24.5, which are high values. Besides, the arithmetic mean of the overall degree is 116.01 and the standard deviation is 14.04. Thus, the informants have a high level of problem solving and the sub-hypothesis is confirmed.

Presentation and analysis of the results of the third sub-hypothesis

It states that there are no statistically significant differences regarding the emotional intelligence level due to the educational level for the students of ISTPSA at the University of Biskra.

Table 8. Comparing the emotional intelligence levels according to the educational level (Bachelor, Masters, PhD).

		Sum of Squares	df	Mean Square	F	Sig.
Intelligent	Between Groups	1454.061	2	727.031	1.452	.242
	Within Groups	30540.876	61	500.670		
	Total	31994.938	63			

Note. Source: Prepared by the researchers.

Table 8 shows that the value of tests to compare the means of the students according to the educational levels is 1.45, which is statistically insignificant because the significance level 0.242 is more than .05. Thus, there are no statistically insignificant differences in the emotional intelligence level due to the educational level for the informants, and the sub-hypothesis is confirmed.

Presentation and analysis of the results of the fourth sub-hypothesis

It states that there are no statistically significant differences regarding the problem-solving skills due to the educational level for the students of ISTPSA at the University of Biskra.

Table 9. to compare the problem-solving levels according to the educational level (Bachelor, Masters, PhD).

		Sum of Squares	df	Mean Square	F	Sig.
Problem solving	Between Groups	956.322	2	478.161	2.541	.087
	Within Groups	11478.662	61	188.175		
	Total	12434.984	63			

Note. Source: Prepared by the researchers.

Table 9 shows that the value of tests to compare the means of the students according to the educational levels is 2.54, which is statistically insignificant because the significance level .087 is more than .05. Thus, there are no statistically insignificant differences in the problem-solving level due to the educational level for the informants, and the sub-hypothesis is confirmed.

Presentation and analysis of the results of the fifth sub-hypothesis

It states that there is a statistically significant relation between emotional intelligence and problem-solving for the students of ISTPSA at the University of Biskra.

Table 10. Correlation between emotional intelligence and the problem-solving capacity.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.531a	.282	.270	12.00178

a. Predictors: (Constant). intelligence

Note. Source: Prepared by the researchers.

Table 10 shows that the coefficient of Pearson correlation between the two variables is 0.531, which is average. As for R-square, it means that the emotional intelligence variable interpreted the variance in the dependent variable (the problem-solving capacity) with a rate of 28.2. The value of the determination coefficient is close to the value of the correlation coefficient based on the size of the sample and the number of independent variables.

Table 11. Tests to interpret the effect of emotional intelligence on the problem-solving capacity for the informants.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3504.335	1	3504.335	24.328	.000b
	Residual	8930.650	62	144.043		
	Total	12434.984	63			

a. Dependent Variable: total
b. Predictors: (Constant), intelligence

Note. Source: Prepared by the researchers.

Based on the value of F, which equals 24.328, the freedom degrees 62, 01, and 63, and the significance level .000, which are less than .05, we refuse the null hypothesis and accept the alternative. Thus, there is an effect for emotional intelligence on the problem-solving capacity.

Table 12. The coefficients of the equation of the line of regression between emotional intelligence and the problem-solving capacity.

Coefficients*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	88.454	5.786		15.288	.000
	Intelligence	.331	.067	.531	4.932	.000

a. Dependent Variable: total

Note. Source: Prepared by the researchers.

The value of T helps accept or refuse the null hypothesis. In this regard, the value is 15.288 and the significance level is .000, which is less than .05. Therefore, we refuse the null hypothesis and accept the alternative. In addition, the value of Beta is 0.531 and positive. Thus, the orientation of the relation between the two variables is positive. From the values in column B, we can determine the equation of the line of regression (Y = ax + b). In this context, b = 88.454, a = 0.331, and thus, Y = 0.331x + 88.454. Based on this, we conclude there is a statistically significant correlation between emotional intelligence and the problem-solving capacity, and the sub-hypothesis is confirmed.

DISCUSSION

The results show that the informants' level of emotional intelligence is low, unlike the results of (Yahi & Khelaifia, 2020), and (Al Harahecha, 2013)due to the differences in population, sample, major, and social environment. Thus, the informants need training on the acquisition of emotional intelligence skills through guiding, psychological, and educational programs. Besides, it is necessary to integrate the emotional intelligence skills within the educational programs to increase the cognitive and emotional skills and the academic achievement of the students (Hitama & Ammour, 2021, p. 103).

Findings show that the problem-solving capacity of the informants is high and they have the qualifications of the academic excellence and of facing the life problems thanks to understanding the problems, the general orientation towards facing and solving the problems, the ability to generate alternatives and take suitable decisions based on the primary data and the target objectives, and the ability to evaluate the results. In this regard, GPS theory of Newwell & Simon (1972) points those problem-solving needs a good representation of the problem through knowing the primary and final states and the accounts. Then, the differences between the primary and the target states are analyzed to choose the suitable calculator. It is an action based on the data of the problem to reduce the gap between the primary and target states and reach solutions. Scientists see that good representation facilitates the process of problem-solving (Bedrina & Rekza, 2004, p. 59).

Findings show no statistically significant differences due to the educational level, as found out by (Hadj Mhamed, 2016) who reported no statistically significant differences in the level of emotional intelligence due to the major and educational level, and by (Mimas, 2013)who found no differences in the means of emotional intelligence due to the major. Since the informants belong to the same academic environment and there are no big temporal differences between the educational cycles (Bachelor, masters, PhD), we find no statistically significant differences in the emotional intelligence level.

Findings show no statistically significant differences in the level of problem-solving due to the educational level. This is also linked to the variable of emotional intelligence, where we find no differences. Based on the statistically significant correlation between the two variables, we find no differences in the dependent variable (the ability of problem-solving). This confirms that mental intelligence alone is not enough for problem-solving, and that emotional intelligence is needed.

Findings show a statistically significant relation between the emotional intelligence and the problem-solving, as confirmed by (Kaddouri & Dhebihi, 2016) who found out a statistically significant relation between the overall degree of the emotional intelligence scale with its dimensions (self-regulation, empathy, self-awareness, motivation, and social communication) and the problem-solving ability. In this regard, self-regulation helps the efficient objective thinking that helps interact with the self, the others, and the social environment. In this context, not finding solutions to problems creates stress and hinders the individual from managing the emotions and the future, because managing the emotions is managing the future (Abu al Nasr, 2008, p. 132).

In addition, we can interpret the relation between emotional intelligence and problem-solving by saying that emotional intelligence involves regulating emotions, self-awareness, empathy, and social communication. Moreover, emotional intelligence is a system of competencies and personal and social skills that affect the ability to deal with life problems and pressures. The individual who has personal abilities can understand, regulate, express, and evaluate the emotions and feelings and, thus, positively solve problems (Kaddouri & Dhebihi, 2016, p. 115).

CONCLUSIONS

We found out that:

- The emotional intelligence level of the students of ISTPSA at the University of Biskra is low.
- The problem-solving level of the students of ISTPSA at the University of Biskra is high.
- There are no statistically significant differences regarding the emotional intelligence level due to the educational level for the students of ISTPSA at the University of Biskra.

- There are no statistically significant differences regarding the problem-solving skills due to the educational level for the students of ISTPSA at the University of Biskra.
- There is a statistically significant relation between emotional intelligence and problem-solving for the students of ISTPSA at the University of Biskra.

AUTHOR CONTRIBUTIONS

The three authors collected, analyzed, and processed the data for this study. The first author was responsible for proposing the study's parameters and general frameworks. Also, data analysis. The other authors collected the study data and analyzed the study data.

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SUSTAINABILITY & SPORTS SCIENCE JOURNAL

ORIGINAL ARTICLE

K-HERO: An innovative tool for motor sciences

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ABSTRACT

The K-HERO represents a groundbreaking advancement in motor sciences due to its integration of advanced sensors, artificial intelligence, and analytical software. This innovative tool enables the precise collection of data on the kinetic and kinematic parameters of human movement, providing a detailed analysis of biomechanics. Its primary applications include rehabilitation, sports training, and scientific research. K-HERO allows for accurate assessment of physical performance, injury prevention, and the optimization of training programs, enhancing movement quality and the sustainability of physical activities.
Keywords: Innovative, Motor sciences, Prevention.

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INTRODUCTION

In recent years, technological advancements have led to a significant transformation in the field of motor sciences, introducing innovative tools and devices capable of enhancing the understanding, assessment, and optimization of physical performance. The increasing availability of advanced technologies, including motion sensors, artificial intelligence, and real-time monitoring devices, has enabled the collection and analysis of data with unprecedented precision. This has had a profound impact across a wide range of applications, from rehabilitation and physical therapy to sports training, scientific research, and injury prevention.

Among the most promising innovations in this landscape, K-HERO by the company Drop emerges as a cutting-edge tool that combines inertial sensors, artificial intelligence, and advanced analytical software. K-HERO is designed to monitor and analyse human movement dynamics in real time, allowing for an accurate and detailed evaluation of biomechanical parameters. Its versatility makes it applicable to various contexts, including enhancing athletic performance, personalizing rehabilitation programs, and conducting in-depth biomechanical analysis in scientific research.

The objective of this article is to explore the technical features of K-HERO, analyse its applications in clinical, sports, and academic fields, and evaluate its potential impact on professional practice in motor sciences. The article will examine the tool's usage for measuring and analysing movements, as well as the benefits it offers for early diagnosis, injury prevention, athletic performance improvement, and rehabilitation. Furthermore, the discussion will address the added value that K-HERO represents for the educational sector, preparing future motor science professionals to engage with emerging technological frontiers and to meet the challenges of an ever-evolving market.

TECHNICAL DESCRIPTION

K-HERO is a device that combines advanced sensors, artificial intelligence, and analytical software to provide precise measurements of human movement dynamics. It features:

- *Inertial Sensors:* Detect accelerations, angular velocities, and spatial orientations.
- *Integrated Software:* Analyses the collected data and delivers detailed real-time reports.
- *Wireless Connectivity:* Allows integration with external devices such as smartphones, tablets, or computers.
- *Advanced Ergonomics:* Designed to adapt seamlessly to the human body without interfering with movement.

Its compact design and ease of use make K-HERO a versatile tool for a wide range of applications, from functional assessment to rehabilitation.

APPLICATIONS IN MOTOR SCIENCES

Rehabilitation and physiotherapy

K-HERO is widely used in rehabilitation, enabling healthcare professionals to monitor patients' motor recovery with high precision. Due to its ability to analyse movement biomechanics, the device is useful for:

- Assessing motor dysfunctions following injury.
- Monitoring progress during the recovery process.

- Personalizing rehabilitation programs based on objective data.

This data-driven approach enhances therapy effectiveness, shortens recovery times, and improves patients' quality of life.

Biomechanical analysis

A Strategic Ally in Movement Assessment Biomechanical analysis is a fundamental tool for understanding human movement in detail, offering an in-depth view of both motor capabilities and potential defects or imbalances. In this context, K-HERO proves to be an indispensable ally, capable of accurately and reliably measuring a wide range of biomechanical parameters, including:

Kinetic and kinematic parameters of movement

K-HERO records and analyses kinematic parameters such as speed, acceleration, and joint angles during movement. Additionally, it measures kinetic parameters, including forces and torque generated during physical activity. The accuracy of these measurements allows for a precise understanding of movement dynamics, helping to determine whether an athlete or patient performs movements correctly or exhibits alterations that could compromise performance or lead to injury.

Functional asymmetries and imbalances

One of K-HERO's most significant applications is its ability to detect functional asymmetries—differences in movement between the right and left sides of the body. This is particularly useful in both sports and rehabilitation contexts, as asymmetries can indicate compensatory mechanisms or muscular imbalances. Identifying and correcting these discrepancies is essential to prevent injuries and ensure optimal performance, especially in disciplines requiring symmetry and coordination.

Energy efficiency during physical activity

K-HERO not only measures movement quality but also analyses the subject's energy efficiency during exercise or physical tasks. This is crucial for optimizing performance, as it helps identify whether an athlete is expending more energy than necessary to execute a specific movement. Energy efficiency is a critical component in both sports, to enhance endurance and performance, and rehabilitation, to prevent the overloading of bodily structures during recovery.

Benefits of biomechanical analysis with k-hero

Performance Optimization: With precise measurements, coaches and industry professionals can design customized training programs focused on improving technique and enhancing physical performance. By analysing forces and movements, specific areas for improvement can be identified and progress monitored over time.

Injury prevention

Early detection of asymmetries or inefficient movements allows for preventive measures to avoid injuries. Incorrect or inefficient movements, if not properly identified, can accumulate over time, causing structural damage or premature wear. K-HERO helps reduce the risk of long-term injuries by improving the sustainability of physical activities.

Personalized rehabilitation

In rehabilitation settings, biomechanical analysis with K-HERO is essential for monitoring recovery and adapting treatment to individual patient needs. For instance, if a patient is recovering from an injury, K-HERO can assess whether the movement is symmetrical and functional, guiding the physical therapist in tailoring the rehabilitation program accordingly.

Sustainability of physical activities

Continuous monitoring of movement biomechanics enables optimization of exercise approaches, making activities less strenuous and more efficient. This not only enhances performance but also promotes longevity in active individuals, whether in sports or everyday contexts where physical activity is often performed sub optimally.

In summary, utilizing K-HERO for biomechanical analysis presents a valuable opportunity to significantly improve human movement quality. By collecting precise and detailed data, it is possible to intervene promptly to correct anomalies, enhance performance, and reduce the risk of injuries, ultimately leading to greater efficiency and long-term physical sustainability.

Sports training

K-HERO represents a highly valuable tool in the world of sports. It can be used to:

- Evaluate athletic performance in disciplines such as running, soccer, tennis, and more.
- Identify areas for technical improvement.
- Optimize workloads while reducing the risk of injury.

The detailed analysis provided by K-HERO allows coaches and athletes to personalize training programs, improve movement biomechanics, and achieve optimal results in less time. This positive impact not only enhances performance but also contributes to the longevity of an athlete's career.

Scientific research

Thanks to the precision of its measurements, K-HERO is particularly useful in academic and research settings. The data collected can be used for:

- Studies on the effectiveness of new training protocols.
- Comparative analyses of different rehabilitation approaches.
- In-depth investigations of movement-related pathologies.

The use of K-HERO in scientific contexts promotes the production of innovative knowledge and the adoption of evidence-based practices, accelerating progress in motor sciences.

Benefits and Innovation K-HERO represents a significant advancement over traditional movement analysis methods. Its main advantages include:

- Real-Time Measurements: The ability to obtain immediate feedback allows for timely and targeted interventions.
- Portability and Flexibility: Its compact, wireless design makes it usable in various environments, from laboratories to sports fields.
- Objective Data: The use of advanced technologies ensures precise and reproducible data collection.
- Adaptability: It can be adapted for various users, ranging from rehabilitation patients to professional athletes.

These features make it a particularly appreciated tool not only by professionals and researchers but also by athletes who can benefit from continuous and personalized monitoring.

POSITIVE IMPACT ON MOTOR SCIENCES

The introduction of K-HERO into motor sciences has a significant impact on various aspects:

- Improvement in Quality of Life: In rehabilitation settings, precise monitoring and personalized therapeutic interventions accelerate recovery and enhance overall patient well-being.
- Optimization of Athletic Performance: Athletes, through the data provided by K-HERO, can identify weaknesses and areas for improvement, refining techniques and maximizing performance.
- Injury Prevention: Movement analysis and the early identification of imbalances or biomechanical errors contribute to reducing the risk of injuries, ensuring greater safety during physical activities.
- Innovation in Training and Rehabilitation Protocols: The use of advanced technologies promotes the development of more effective and targeted approaches, redefining the standards of motor sciences.

Empirical evidence

A recent survey conducted at the University of Urbino involved students from the degree program in Motor Sciences, revealing significant data regarding interest in K-HERO. According to the results, 70% of the surveyed students expressed a willingness to work with this technological tool, identifying it as a key opportunity to enhance their professional skills and address the challenges of the field.

Respondents highlighted three main reasons behind their enthusiasm for K-HERO:

- Technological Innovation: Students emphasized that K-HERO's ability to offer precise measurements and detailed analyses represents a clear advantage over traditional methods of human movement assessment. Its use is seen as an opportunity to acquire skills aligned with the latest innovations in motor sciences.
- Application Versatility: Students recognized the potential of K-HERO in a variety of contexts, including rehabilitation, sports training, and scientific research. This flexibility makes it useful both for those pursuing a clinical career and for those aspiring to work with professional athletes.
- Workforce Preparation: The use of K-HERO is perceived as an added value in academic training, allowing students to enter the labour market with advanced skills and the ability to operate state-of-the-art technological tools. This aspect is particularly relevant in an increasingly competitive and data-driven job market.

Implications of the study

The findings reflect a growing interest among new generations in integrating innovative technologies into motor sciences. Seventy percent of respondents also emphasized that tools like K-HERO not only enhance professional approaches but also increase confidence in their ability to deliver personalized and effective interventions to future clients or patients.

Furthermore, the collected feedback highlights a trend toward greater use of advanced technologies in academic curricula, suggesting that educational institutions could benefit from incorporating tools like K-HERO into their study programs. This integration could contribute to training a new generation of highly skilled motor science professionals capable of meeting the demands of an evolving sector.

CONCLUSIONS

K-HERO represents a paradigmatic example of how technology can enhance motor sciences. Its versatility, combined with the accuracy of its measurements, makes it a valuable tool in various contexts: from rehabilitation to biomechanics, from sports training to scientific research. With tools like K-HERO, the future of motor sciences is increasingly oriented towards a data-driven, integrated approach, capable of significantly improving both quality of life and physical performance for individuals and athletes.

Moreover, the results of the initial applications suggest substantial potential for further developments. The survey conducted at the University of Urbino indicates that the majority of Motor Science students are interested in working with tools like K-HERO, signalling that new generations recognize the value of technological innovation.

The study on K-HERO will continue, exploring a practical comparison with the virtual reality system RIABLO. This research phase aims to identify the strengths and weaknesses of each approach, evaluating which technology best meets different needs in rehabilitation and motor performance enhancement. This comparison will provide further insights into the future use of advanced technologies in motor sciences, expanding opportunities for professionals and researchers in the field.

AUTHOR CONTRIBUTIONS

R.G.B conceptualized the study, designed the research methodology, and supervised the overall project. R.S conceptualized the study, designed the research methodology, and supervised the overall project. D.F. contributed equally to the study. M.S. contributed equally to the study. C.B. conceptualized the study, designed the research methodology, and supervised the overall project.

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SUSTAINABILITY & SPORTS SCIENCE JOURNAL

REVIEW ARTICLE

Physical exercise effects on weight during pregnancy: A review

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ABSTRACT

Regular physical activity has numerous benefits, including reducing the risk of gestational diabetes, hypertension and pre-eclampsia, promoting healthy weight gain and reducing the risk of postpartum depression. This paper's primary objective was to search for the most recent research on the effects of physical exercise on weight control during pregnancy. We searched in PubMed for, Studies of the last 10 year (2014-2024). Free full texts studies randomized controlled trials studies. From 38 results only 7 studies were selected to be part of this review. A total of 1383 (aged 18 to 40 years) pregnant women were recruited to be part of these studies. Different types of physical activity intervention programs were used focusing on the management of weight during pregnancy. Promoting a healthy weight increase throughout pregnancy, physical exercise especially in the second part of pregnancy can bring general benefits on weight management also in pregnant women overall health. More review studies with a larger sample size, more specifics, and a variety of interventional exercise program types are needed to highlight more effective exercise programs (and their combinations) and improve the quality of scientific research-based information about weight gain management during pregnancy.

Keywords: Sport health, Effects, Exercises, Pregnancy, Physical activity.

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INTRODUCTION

Obesity in pregnant women is associated with reproductive challenges, such as reduced fertility and increased maternal and foetal risks during pregnancy (Blomberg, 2011). According to Checheir (2011), obesity also increases the possibility of a pregnant woman being at risk of possible ischemic stroke in the future, from type 2 diabetes, osteoarthritis, gall bladder disease, hypertension, coronary heart disease and a number of malignancies, including breast and colon cancer. Weight gain during pregnancy is a predisposing factor for obesity in the future, as women with excessive gestational weight gain (GWG) also are more likely to have high postpartum weight retention (PPWR) (Siega-Riz et al., 2009) and their children to have an increased risk of later overweight or obesity (Oken et al., 2007). Pregnancy and delivery difficulties are less likely to occur in women who gain the required amount of weight (Streuling et al., 2010; Da Silva et al., 2017). In pregnancy and childbirth, pre-training can facilitate birth and prevent complications (Thornton et al., 2006) (Márquez et al., 2009 (b)).

A vital component of a healthy lifestyle, physical exercise is described as a planned, structured physical activity carried out to enhance one or more aspects of physical fitness, helping to prevent and treat certain diseases (Davenport et al., 2018 (a)). Because pregnancy is linked to greater incentive to maintain or begin a healthy lifestyle and more frequent medical checkups, which make exercise tracking easier, it's a fantastic time to begin training (Davenport et al., 2018 (b)). Regular exercise during pregnancy has several benefits, including reducing the risk of postpartum depression, excessive weight gain and management in the postpartum period, as well as hypertensive problems and gestational diabetes (Davenport et al., 2018 (a); Davenport et al., 2018 (a)). Another interesting and healthful approach to keep active throughout pregnancy is via aquatic-aerobic exercise. It has several benefits for the health of the pregnant woman such as reducing the risk of miscarriage, less oedema, increased diuresis, lower arterial pressure and less back pain. It also enables pregnant women to interact emotionally with one another (Rising & Senterfitt, 2009). Along with worries about the possible hazards of exercise, pregnant women are not adequately encouraged to engage in regular exercise, which leads to their abandonment or unwillingness to begin at this time (Coll et al., 2016). Pregnant women who engage in regular physical activity during the first six months of their pregnancy have a lower risk of caesarean delivery; this is because physical activity at the right intensity during pregnancy makes childbirth easier during the second stage (Krzepota et al., 2018).

Objective

This paper's primary objective was to search for the most recent research on the effects of physical exercise on weight control during pregnancy.

METHODOLOGY

We searched in PubMed using the keywords; Effects; Exercises During Pregnancy; Pregnancy; Physical Activity. Filters applied were: Studies of the last 10 year (2014-2024), Free full texts studies, Randomized controlled trials studies. Exclusion criteria: Studies that included subjects with different maternal diseases such as: pre-eclampsia, cardiac diseases, deep anaemias, rheumatic disease or special interventions in the mother's body that recommend restriction of movements.

RESULTS

From 38 results only 7 studies were selected to be part of this review.

1. Ronnberg et al., 2016

2. Mizgier et al., 2018
3. Brik et al., 2019
4. Darvall et al., 2020
5. Navas et al., 2021
6. McDonald et al., 2022
7. Roland et al., 2023

Table 1. The final 6 selected studies.

Nr	Author, year of publication	Subject number and age	Exercise intervention duration
1	Ronnberg et al., 2016	445 women randomized, 267 remained for analysis at ≤16 weeks postpartum and 168 at 1 year postpartum.	1 year postpartum.
2	Mizgier et al., 2018	57 pregnant females.	18 weeks
3	Brik et al., 2019	A total of 120 women.	8 months
4	Darvall et al., 2020	30 obese pregnant women aged ≥18 years with a BMI (weight in kilograms/height in m^2) ≥30 kg/m^2.	3 months
5	Navas et al., 2021	320 women.	12 weeks
6	McDonald et al., 2022	192 women (18–40 years).	24+weeks
7	Roland et al., 2023	219 pregnant women in good health who were not active had a median pre-pregnancy BMI of 24.1 (21.8–28.7) kg/m^2.	4 years 2018–2021

DISCUSSION

A total of 1383 (aged 18 to 40 years) pregnant women were recruited to be part of these studies. Different types of physical activity intervention programs were used including; yoga, swimming, and stationary bike exercises, aerobic activities, strengthening exercises, coordination and balance exercises, pelvic floor exercises, brisk walking, dancing, aquatic exercises, stretching and relaxation, and any combination of these group exercises, focusing on the management of weight during pregnancy. The primary goal of the Ronnberg et al. (2016) study was to determine if a prenatal intervention might lower postpartum weight retention (PPWR) when compared to routine care. The exercise intervention was focused on the individual education which was based on BMI category and was part of the intervention approach during the first prenatal appointment. A customized graph with the suggested weight growth interval shown on it was added to the data. There were official recommendations for exercise. The type and quantity of exercise recommended was modified based on prior activity levels and any pregnancy-related restrictions.

At every prenatal appointment and upon admission to the delivery ward, the mother's weight was measured, discussed, and documented in the case files and on the graph. In Mizgier et al., 2018 study, the main goal was to carefully carry out designing a physical activity program for 18 weeks with pregnant women and its long-term continuation second and third trimesters, to determine its impact on obstetric outcomes (birth weight, mode of delivery, week of pregnancy at birth and weight gain during pregnancy) to patients with different durations of physical activity. Pregnant women in the examined groups were compared based on body mass index (BMI), weight, height, age, and date of assessment. Movement activitie**s** for pregnant women, such as yoga, swimming and stationary cycling exercises, are safe and the only ones included in the fitness regime. The exercises were performed under instructions of licensed physical therapists. The main objective of Brik et al., 2019 study was to assess the relationship between mother gestational weight

increase and foetal cardiac function and physical activity during pregnancy. The exercise intervention was focused on week's 9–38, the women in the exercise group participated in three 60-minute sessions each week as part of a supervised physical conditioning program. Warming up for ten minutes, aerobic activities for twenty-five minutes, strengthening exercises for ten minutes, coordination and balance exercises for five minutes, pelvic floor exercises for five minutes, and stretching and relaxation for five minutes were all part of each session. The recommended level of aerobic exercise was mild to moderate (55–60% of maximal heart rate).

The Darvall et al., 2020 study objective was to evaluate a pedometer-based strategy to increase exercise and decrease excess gestational weight gain (GWG) in expectant mothers. 30 obese pregnant women were given Fitbit Zip pedometers and randomly assigned to one of three groups: app-coach (a behavioural change program offered by a health coach), control (pedometer only), or app-coach (pedometer connected to the patient's own smartphone with self-monitoring of activity). The exercise intervention program was based on written materials on pregnancy and exercise, such as the Australian Physical Activity and Sedentary Behavior Guidelines, were given to all research participants at the time of recruitment. Basically, general recommendations for physical activity are given: 150 minutes per week, or at least 30 minutes of moderate physical activity most days of the week. Examples of activities that correspond to a reasonable or very active level of physical activity as defined by pedometer which includes brisk walking, jumping, sweeping, window washing and pushing stroller than the child.

Analysing the effects and safety of moderate intensity water aerobic exercise. this program for postpartum depression, sleep problems and quality of life in women one month after birth was the aim of the research Navas et al., 2021. A control group (regular prenatal care) and an intervention group (moderate aerobic water activity) were randomly selected 320 pregnant women. where sleep quality (MOS sleep), quality of life (EQ-5D) and presence of anxiety or sadness (EPDS) which was measured one month after birth. Scientists concluded that moderate-intensity aquatic exercise during pregnancy was safe for both mothers and their unborn children and reduced postpartum anxiety and symptoms of depression in mothers. The goal of the study conducted by McDonald et al., 2022, was to ascertain how various forms of mother activity during pregnancy affected the health of the unborn child. The framework of the exercise program included a 5-minute warm-up, 50 minutes moderate-intensity exercise (40-59% VO_{2max}) and a 3-5-minute rest per each exercise session. Using treadmill, elliptical, recumbent bike, rowing or stair equipment, the aerobic exercise group engaged in moderate-intensity exercise. At a moderate intensity, the resistance training group performed two to three sets of fifteen repetitions of each exercise.

Roland et al., (2023) study aim was, to examine the motivational impact of physical activity (MOT) through organized supervised exercise training (EXE) on GWG, obstetric and neonatal outcomes throughout pregnancy. So, the primary goal of the exercise intervention was to examine and the impact of two separate exercise treatments (EXE and MOT) on moderate-to-vigorous physical activity during pregnancy compared to CON was the primary objective. Three times a week, the intervention group received one hour of moderately intense supervised exercise instruction, which included two sessions in a gym and one in a pool. Aerobics and Resistance training activities at the gym included 30 minutes of stationary cycling and 30 minutes of resistance band exercise. The participants spent 45 minutes exercising in water with plates, balls and other objects in the pool and 15 minutes of swimming. BT intervention included a weekly text message tailored to encourage increased physical activity as well four one- to two-hour motivational physical activity sessions throughout pregnancy. Leite CF et al. claim that some research on mothers and children have given inconsistent results because there is no meaningful correlation between physical activity and clinical outcomes; instead, "*lack of physical activity affects*" more than "*negative effects*" of physical activity were

observed. According to the study by Brik et al (2019), exercise during pregnancy does not reduce maternal weight gain, but promotes Postpartum weight reduction, according to research findings. The current study found that women who exercised throughout pregnancy experienced considerably greater maternal weight reduction after birth; the statistically significant finding may be explained by the increased sample size. The study of Darvall et al., (2020) observed no difference in step count each day active minutes or decrease in weight gain between groups. The results of this study suggest that pregnant obese women can use a pedometer that can sync data with their own smartphones.

According to the findings of the McDonald et al., (2019) study, aerobic capacity in the early stages of pregnancy predicted the risk of caesarean delivery, and exercise during pregnancy decreased the relative risk of caesarean birth rates, but not significantly. Prior studies have shown that fitness level reduces inflammatory markers, such as C-reactive protein, linked to metabolic phenotype, independent of BMI (Agostinis-Sobrinho et al., 2020). Roland et al.'s (2023) findings indicate that neither motivational counselling (MOT) nor supervised exercise training (EXE) had an impact on gestational weight gain (GWG) or obstetric and neonatal outcomes in healthy pregnant women when compared to the control group. These findings contradict other studies that demonstrated that, in comparison to conventional therapy (Ming et al., 2018), healthy (Díaz-Burrueco et al., 2021) and normal-weight women had decreased GWG after prenatal exercise. However, other research (Da Silva et al., 2017; Stafne et al., 2011) found no effect of exercise on prenatal GDM preeclampsia, premature birth and birth weight, which is comparable to the current study.

CONCLUSIONS

Based on the reviewed studies it is well documented that promoting a healthy weight increase throughout pregnancy, physical exercise especially in the second part of pregnancy can bring general benefits on weight management also in pregnant women overall health. Also, sustaining a moderate degree of physical exercise throughout pregnancy may aid in the foetal heart's growth and encourage postpartum weight loss. Lifestyle intervention with moderate long-term physical activity Pregnancy can reduce weight and also improve neonatal birth weight, exercise before and throughout pregnancy can reduce the chance of caesarean delivery in overweight and obese women.

Recommendations

Studies with bigger populations are needed to observe the effects of a long-term physical exercise program on the course and results of pregnancy. To better understand how does physical activity affect some outcomes during pregnancy and to identify the best strategies, including those with the optimal frequency and intensity of exercises to prevent weight gain during pregnancy is further study is needed. More review studies with a larger sample size, more specifics, and a variety of interventional exercise program types are needed to highlight more effective exercise programs (and their combinations) and improve the quality of scientific research-based information about weight gain management during pregnancy.

AUTHOR CONTRIBUTIONS

PhD(c) Elga Damo: Acted as the primary author, conducted the research, performed the literature review, and drafted the manuscript. Prof. Dr. Bardhyl Misja: Supervised the research process, provided scientific input, and reviewed the manuscript, contributing to its academic quality and final form. Both authors have reviewed and approved the final version of the manuscript prior to submission.

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SUSTAINABILITY & SPORTS SCIENCE JOURNAL

ORIGINAL ARTICLE

Parental sports experience and children's participation in after-school sports activities

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ABSTRACT

This study examines the impact of parents' sports experience on children's involvement in extracurricular sports activities. Children's participation in sports is influenced by a variety of factors, with the influence of parents identified as a key component. Previous studies have shown that parental support and the examples they set are important in the development of children's sports habits (Gould & Carson, 2008; Jackson & Johnson, 2013). Parents influence not only through practical and emotional support but also through role modelling, cultural beliefs, and economic resources (Tucker & Gill, 2016). The study was based on an analysis of data from a survey conducted with 265 elementary school students, assessing the connection between parents' sports experience and children's participation in after-school sports activities. The results showed that 54% of students engaged in extracurricular sports activities had parents with a sports background, compared to only 23% of those who were not involved. Statistical analysis revealed a strong positive correlation between parents' sports experience and children's sports participation, with a very low p-value ($p < .000001$). This indicates that parents play a significant role in the development of children's sports habits, while other factors such as family culture and financial support contribute to their motivation and involvement (Vella et al., 2017). This study suggests that improving participation in physical activities can be achieved through active parental involvement and the creation of equal opportunities for all children, regardless of socio-economic status.

Keywords: Education technology, Educational innovation, Survey, Pupils, Physical activities, Parents' sports history, Elementary schools.

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INTRODUCTION

Children's participation in extracurricular sports activities is influenced by a variety of factors, with parental influence emerging as a key component. Parents affect not only through practical and emotional support but also through their role modeling, cultural beliefs, and the economic resources they have available. This literature is supported by studies from the fields of sports psychology, sociology, and physical education. Research has shown that parental support, both emotional and practical, is a powerful factor that influences children's motivation to engage in and continue participating in sports outside of school (Fredricks & Eccles, 2005; Knight, Dorsch, Osai, Haderlie, & Sellars, 2016). Support includes providing logistics such as transportation, payment for equipment and registrations, as well as presence at sporting activities as spectators or supporters. Parents who show interest and communicate positively about sports directly influence children's self-confidence and enjoyment during participation (Babkes & Weiss, 1999). Support perceived as non-critical and consistent helps in creating a long-term connection between children and sports. According to Brustad (1993), children often model their parents' behaviors regarding physical activity. When parents are themselves involved in sports or regular physical activity, it sends a clear message about the importance of physical activity as part of daily life.

Scholars such as Pugliese and Tinsley (2007) have shown a strong positive correlation between parents' activity level and children's participation. Additionally, family cultures that prioritize physical well-being create an environment that supports active participation in sports (Wheeler, 2011; Moore et al., 1991). These influences are most pronounced in younger children who are still dependent on family values and routines. Direct parental involvement in sports (as volunteers, organizers, or coaches) has been identified as a factor that increases cohesion and satisfaction in sports activities (Holt et al., 2008). According to Dorsch, Smith, and Dotterer (2016), parental involvement can be positive when it focuses on the child's development rather than just sporting success. However, excessive involvement or high pressure can have negative effects, causing stress and lack of autonomy in children (Harwood & Knight, 2015). Therefore, a balanced approach to involvement is essential for a healthy sports experience. Accessibility to sports is often influenced by parents' socio-economic status. Families with higher incomes are more likely to afford the financial costs of sports activities, including memberships, travel, and equipment (Sabo & Veliz, 2008; Eime et al., 2013). In contrast, children from lower-income families are often excluded due to economic barriers and lack of institutional support. Furthermore, the level of education of parents influences their awareness of the importance of participation in physical and sports activities, affecting the choices they make for their children (Dagkas & Stathi, 2007).

Gender stereotypes play an important role in how parents approach sports for boys and girls. Studies such as those by Coakley (2006) and Hardin & Greer (2009) show that in many cultures, boys are encouraged more for competitive and physical sports, while girls are directed towards "*softer*" or artistic activities. This gender influence is often unconscious and affects the selection of sports, self-confidence, and the sustainability of children's participation in physical activities.

A review of the literature indicates that parents play a multifaceted role in children's participation in extracurricular sports activities. This influence includes moral support, role modeling, financial assistance, active involvement, and cultural influences. Policies to increase children's participation in sports should include an inclusive approach to the family, helping parents to become aware and involved in a balanced and positive way.

METHODOLOGY

This study was conducted through a structured survey aimed at identifying the impact of parents' sports experience on children's involvement in extracurricular sports activities. The survey was conducted among 265 pupils, aged 8-9, from elementary schools in Shkodër, enrolled in the 9-year cycle. They were asked about their participation in physical activities and their parents' sports history.

The survey questions included the following aspects:

1. Whether the pupils participates in sports or physical activities after school.
2. Whether the parents of students who participate in sports have a sports background.
3. Whether the parents of students who do not engage in sports have any experience with sports.
4. A comparison between parents with and without sports experience regarding their children's participation in extracurricular activities.

Data were collected manually and/or through an online form, ensuring confidentiality and anonymity of the participants. Statistical methods were used to analyze the results, comparing groups and identifying trends related to the family influence on children's physical activity habits.

RESULTS

The data collected from 265 students showed that 90 of them (34%) participate in sports or physical activities after school hours. Of these, 49 students (54%) have parents who have had a sports background, while 41 students (46%) have parents who have not been involved in sports activities in the past. Out of the 175 students who do not engage in extracurricular sports activities, 40 of them (23%) have parents with sports experience, while 135 (77%) have parents who have not practiced sports before.

Table 1. Data analysis.

Pupils Category	Number of pupils	Percentage of pupils	Parents with Sports Experience	Percentage of Parents with Sports Experience	Percentage of Parents with Sports Experience	Percentage of Parents Without Sports Experience
Pupils participating in sports activities after school	90	34%	49	54%	41	46%
Pupils who do not participate in sports activities after school	175	66%	40	23%	135	77%

To assess whether there is a statistically significant relationship between parents' sports experience and children's participation in sports, a *p*-value of .00000052 was obtained, which is much smaller than the significance level $\alpha = .05$. This indicates a highly statistically significant relationship between parents' sports experience and children's participation in physical activities.

This suggests a strong connection between parents' sports experience and children's involvement in extracurricular activities.

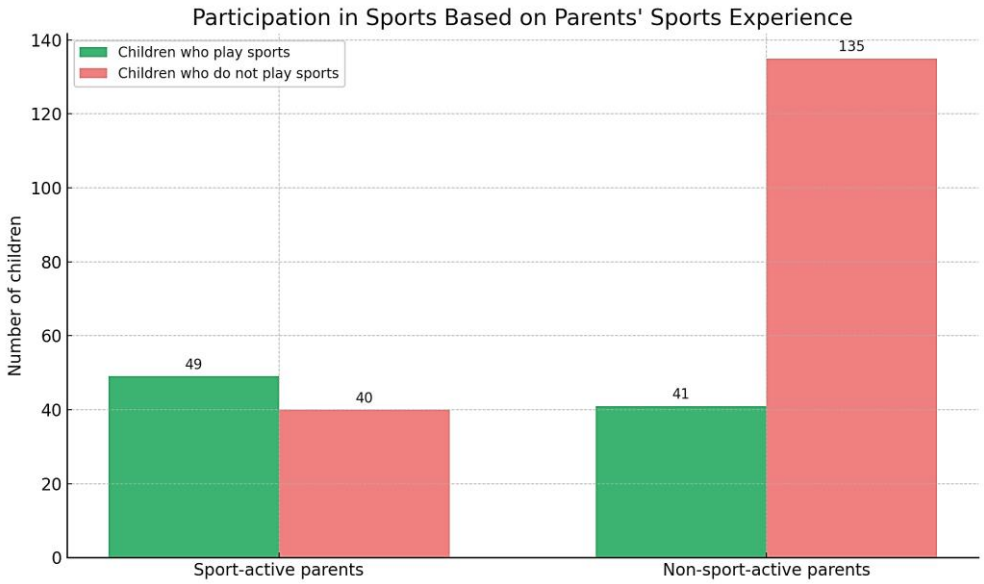

Figure 1. Children who do sports and children who do not do sports.

Figure 1 clearly shows the difference in children's participation in extracurricular sports activities, depending on their parents' sports experience. As seen, children with sporty parents have a significantly higher level of involvement.

Correlation between parents' sports experience and children's participation in sports:

Table 2. Provide table title.

Pearson ® correlation coefficient	0.317
***p*-value = 1.38 × 10^{-7}**	$p < .000001$

This result indicates a moderate and statistically significant positive correlation between whether parents have had sports experience and their children's participation in extracurricular sports. In other words, children are more likely to engage in sports if their parents were involved in sports in the past.

Further statistical analysis using Pearson's correlation coefficient provided a value of r = 0.317, with a very low p-value ($p < .000001$), confirming that there is a positive, moderate, and statistically significant correlation between parents' sports experience and their children's participation in extracurricular sports. This result suggests that family sports culture is a significant influencing factor in children's physical behavior.

DISCUSSION

The findings of this study align with several previous works that emphasize the importance of parental influence in shaping children's physical behaviors.

Parental Modeling Influence: The results showed that children with parents who have a sports background are more likely to engage in sports activities. This aligns with Moore et al.'s (1991) study, which demonstrated a clear link between parents' physical activity levels and those of their children. Active parents serve as behavior models, encouraging imitation and adoption of a similar lifestyle by their children.

Sports Socialization in the Family: Fredricks & Eccles (2005) emphasize that family sports socialization, through emotional and logistical support, significantly affects children's motivation and participation in sports. Similarly, this study shows that parental support is a key factor in children's involvement in extracurricular physical activities.

Parental Pressure and Expectations: While this study did not directly measure parental pressure, it is important to mention the work of Dorsch et al. (2016) and Coakley (2006), who caution that parental involvement can sometimes take negative forms, such as performance pressure or high expectations, which in some cases may reduce children's enjoyment and motivation for sports.

Family Culture and Social Structure: Wheeler (2011) and Dagkas & Stathi (2007) highlight the significant role of family culture and social structure in creating an environment that either encourages or discourages physical activity. The data from this study suggest that a lack of sports experience in parents often coincides with a lack of children's involvement, indicating the impact of overall family culture and the social environment.

Psychological and Logistical Support: Harwood & Knight (2015) stress the importance of balancing practical and emotional support from parents. Although this study did not measure this aspect directly, it hypothesizes that parental involvement goes beyond just sports experience—it includes attitudes, emotional support, and logistical resources.

CONCLUSIONS

The Impact of Parental Sports Experience on Children's Activities: A significant portion of students (54%) involved in extracurricular sports have parents with a sports background. This provides strong evidence that parents' sports experience can influence children's participation in similar activities. Conversely, only 23% of students who do not engage in sports outside of school have parents with sports experience, suggesting that parental influence is stronger when parents have a history of involvement in sports.

Family Culture and Motivation for Sports: Family culture appears to play a significant role. Children whose parents are engaged in sports activities are more likely to be active after school, perhaps due to stronger and more encouraging attitudes from parents about engaging in physical activities. In contrast, children from families where parents have no sports experience are more likely to be disengaged from physical activities outside of school.

Participation Percentages: Data collected shows that 34% of students are active in extracurricular sports, a percentage that suggests there is still room to increase physical activity participation among children. This also suggests that, in addition to parental influence, other factors (such as opportunities provided by schools or communities) may also influence student participation in sports.

Improving Participation: The data suggests that to increase student participation in physical activities, initiatives may need to be taken to encourage parents to engage more in sports activities or to create more opportunities for children to connect with physical activities, regardless of their parents' sports experience.

In general, parental influence is evident in children's participation in extracurricular sports, and this could be used as a starting point for developing strategies to encourage higher participation in physical activities among students.

AUTHOR CONTRIBUTIONS

The contribution to this study is joint, where Erjon Peqini is a PhD candidate and Bardhyl Misja is his scientific leader.

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