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THE INFLUENCE OF BALL ELASTICITY ON THROWING SPEED AND GRIP STRENGTH IN FEMALE HANDBALL PLAYERS

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ABSTRACT. Introduction: This study examines ball elasticity's impact on throwing speed and palmar strength in female handball players. **Objective:** We hypothesize that ball elasticity influences throwing speed and palmar strength. **Methods:** Nine players were grouped by ball elasticity and underwent grip strength measurements, throws, and exercise. **Results**: Exercise had no significant throwing speed effect; palmar strength decreased. Elasticity showed minimal differences, but hard balls slightly impacted post-exercise speed. **Conclusion:** Exercise impacted palmar strength, but not throwing speed. Elasticity subtly affected post-exercise speed.

Keywords: *Ball Elasticity, Throwing Speed, Palmar Strength, Handball, Exercise-Induced Fatigue*

REZUMAT. ***Influența elasticității mingii asupra vitezei de aruncare și a forței de strângere a mâinii la jucătoarele de handbal.*** **Introducere**: Acest studiu examinează impactul elasticității mingii asupra vitezei de aruncare și a forței palmare la jucătoarele de handbal. **Obiectiv**: Emitem ipoteza că elasticitatea mingii influențează viteza de aruncare și puterea palmară. **Metode**: Nouă jucători au fost grupați în funcție de elasticitatea mingii și au fost supuși măsurătorilor de forță de prindere, aruncări și exerciții. **Rezultate**: Exercițiul nu a avut un efect semnificativ asupra vitezei de aruncare; puterea palmară a scăzut. Elasticitatea a arătat diferențe minime, dar mingile dure au afectat ușor viteza post-exercițiu.

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Concluzie: Exercițiul a afectat forța palmară, dar nu viteza de aruncare. Elasticitatea a afectat subtil viteza post-exercițiu.

***Cuvinte cheie**: elasticitate a mingii, viteză de aruncare, forță palmară, handbal, oboseală indusă de exercițiu*

INTRODUCTION

Handball is a dynamic and physically demanding team sport that requires a unique combination of technical skills, physical attributes, and strategic thinking (Gandevia,2001; Steib et al.,2013). As one of the most popular team sports worldwide, handball garners significant attention, especially in its female variant. The success of a handball team hinges upon the prowess of its players in various aspects, such as throwing accuracy, strength, and overall hand function (Barbieri et al., 2017). This study delves into a comprehensive examination of the female handball player model, with a specific focus on two pivotal factors: throwing strength and palmar dynamometry.

The act of throwing in handball involves intricate biomechanics and muscular coordination. The force exerted during a throw is a critical determinant of the accuracy and speed of the projectile (Thorlund et al., 2008). Furthermore, a player's ability to maintain consistent throwing strength throughout a match influences their overall performance and the team's success. This study aims to unravel the nuances of throwing strength in female handball players, considering factors such as muscular development, technique, and training regimens (Foster et al., 2001).

In addition to throwing strength, palmar dynamometry, which assesses grip strength, plays a pivotal role in a handball player's overall performance. A player's grip strength can significantly impact their ability to control the ball, fend off opponents, and engage in various game-related activities (Nocella et al. 2011; Fitts, 1994). Understanding the relationship between grip strength and handball performance is crucial for optimizing training programs and enhancing player capabilities.

This article delves into a theoretical exploration of the key components underpinning the female handball player model (Noakes, 2000). By investigating throwing strength and palmar dynamometry, we aim to provide valuable insights that can inform training methodologies, player selection criteria, and performance evaluation metrics (Beaulieu, 2008). As the sport of handball continues to evolve, bridging the gap between theoretical understanding and practical application is essential for nurturing successful female handball players and elevating the overall quality of the game.

HYPOTHESIS

We postulate that the elasticity of the ball used in female handball significantly influences both throwing speed and palmar strength. Specifically, we anticipate that the exercise-induced fatigue protocol will yield a reduction in palmar strength measurements, reflecting the temporary muscular fatigue resulting from the exercises. Regarding throwing speed, we hypothesize that the exercise-induced fatigue will lead to a decrease in throwing speed due to the compromised muscular strength and coordination resulting from fatigue.

MATERIALS AND METHODS

Participants

Nine female handball players, from C.S. Universitatea Cluj, each with varying levels of experience, were recruited for the study. Participants were divided into three groups, with three participants in each group. The groups were distinguished based on the type of ball used: soft, medium, and hard elasticity. Prior to participation, all participants provided informed consent, and their demographic and anthropometric information was collected.

Equipment

1. **MbientLab MetaMotionS (Accelerometer):** The MbientLab MetaMotionS accelerometer is a sophisticated wearable device designed to measure and record acceleration, motion, and orientation data. This compact and lightweight sensor is seamlessly integrated into the study to capture the nuanced movements and actions of female handball players. The accelerometer's advanced technology enables the precise quantification of throwing motions, aiding in the assessment of throwing strength and technique. Through its wireless connectivity, the MetaMotionS facilitates real-time data transmission to a connected device, allowing researchers to analyze and interpret the intricate dynamics of the players' movements during handball activities.
2. **Palmar Dynamometer:** The palmar dynamometer is an essential tool used for assessing grip strength — the force exerted by the hand's muscles while gripping an object. In this study, the palmar dynamometer is employed to measure the hand strength of female handball players. By quantifying grip strength, researchers can gain insights into the players' hand function, which directly influences their ability to control the ball, fend off opponents, and

engage in various game-related actions. The dynamometer provides accurate and standardized measurements, ensuring consistency and reliability in evaluating the players' hand strength. We used a hand-held spring activated dynamometer from Ralondbey.

3. **Rubber Balls:** Rubber balls serve as the primary projectiles in handball and are utilized for various throwing exercises and measurements. These standardized rubber balls replicate the size, weight, and texture of the balls used in official handball matches. Throughout the study, participants engage in controlled throwing exercises using the rubber balls. These exercises not only facilitate the evaluation of throwing strength but also enable researchers to analyze throwing accuracy and technique. By using standardized rubber balls, the study ensures uniformity in the testing conditions and enhances the validity of the findings. We have used standard handball balls size 3.

4. **Stopwatch:** The stopwatch is an indispensable timing device used to precisely measure the duration of various handball-related activities. Researchers employ the stopwatch to record the time taken for actions such as throwing a rubber ball, completing specific drills, and performing agility exercises. Accurate timing is crucial for assessing the speed of throws, reaction times, and overall performance. The stopwatch contributes to the collection of quantitative data, allowing researchers to analyze the temporal aspects of players' actions and correlate them with other measured parameters.

These equipment components synergistically contribute to the comprehensive examination of female handball players' capabilities. The MetaMotionS accelerometer captures nuanced movement patterns, the palmar dynamometer quantifies grip strength, rubber balls replicate game-like conditions, and the stopwatch ensures accurate timing — combined, these tools empower researchers to uncover valuable insights into the intricate dynamics of female handball performance.

Procedure

1. **Baseline Measurements:** Before engaging in any physical activities, participants' baseline grip strength was assessed using the palmar dynamometer. Each participant performed three maximum-effort grip squeezes with each hand, alternating between hands. The average grip strength for each hand was recorded.

2. **Group Allocation:** Participants were randomly assigned to one of the three groups based on the elasticity of the ball they would use: soft, medium, or hard.

3. **Pre-Exercise Accelerometer Measurements:** Participants were equipped with the MetaMotionS accelerometer, securely fastened to their throwing arm. Each participant from each group performed 7-meter throws using their designated ball elasticity. Two trials of 7-meter throws were conducted for each participant, and the accelerometer recorded the kinematic data of each throw.
4. **Exercise Protocol:** After the pre-exercise measurements, participants engaged in the palmar flexion exercise protocol using the designated ball elasticity. They completed 10 isometric repetitions of the palmar flexion exercise, gripping the ball as forcefully as possible.
5. **Post-Exercise Accelerometer Measurements:** Following the exercise protocol, participants repeated the 7-meter throws using their designated ball elasticity. Similar to the pre-exercise phase, two trials of 7-meter throws were performed for each participant, and the accelerometer captured the kinematic data of each throw.
6. **Post-Exercise Palmar Dynamometer Measurements:** Immediately after the post-exercise throws, participants' grip strength was measured once again using the palmar dynamometer. Three maximum-effort grip squeezes were performed with each hand, alternating between hands. The average grip strength for each hand was recorded.
7. **Data Analysis:** The accelerometer data from the 7-meter throws were analyzed to evaluate throwing strength, technique, and consistency within each elasticity group. Grip strength measurements before and after the exercise protocol were compared for each group to assess the impact of the exercise on participants' hand strength.

Statistical Analysis

Descriptive statistics (mean, standard deviation) were calculated for grip strength measurements and accelerometer data within each group. Paired t-tests were conducted to analyze grip strength changes before and after the exercise protocol within each group. Analysis of variance (ANOVA) was employed to assess any significant differences in accelerometer data between pre-exercise and post-exercise throwing trials within each group. All the statistical analysis has been done for a statistical significance threshold of .05 (p value).

Ethical Considerations

The study adhered to ethical guidelines and received approval from the Faculty of Physical Education and Sport, Babeş-Bolyai University. All participants provided informed consent, and their privacy and data security were ensured throughout the study.

By incorporating different ball elasticities and grouping participants accordingly, this methodology aims to explore the potential impact of ball elasticity on grip strength, throwing dynamics, and overall performance among female handball players.

RESULTS

Table 1. Paired sample t-test between initial and final measurement conditions

		Mean	N	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1	ThrowSpeedMax_M2	84.67	9	6.34	.679	8	.517
	ThrowSpeedMax_M1	82.75	9	7.73			
Pair 2	ThrowSpeedMin_M2	4.98	9	1.12	-1.156	8	.281
	ThrowSpeedMin_M1	5.37	9	.95			
Pair 3	PalmStrength_M2	37.22	9	9.55	-4.163	8	.003
	PalmStrength_M1	50.22	9	16.76			

Table 2. Independent sample t-test between soft and medium ball conditions

	Group	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)
ThrowSpeedMax_M1	1	3	84.65	4.30	.514	4	.634
	2	3	82.58	5.51			
ThrowSpeedMin_M1	1	3	5.07	1.39	-.648	4	.553
	2	3	5.68	0.88			
ThrowSpeedMax_M2	1	3	87.01	2.77	.067	4	.950
	2	3	86.60	10.31			
ThrowSpeedMin_M2	1	3	5.34	1.43	-.001	4	.999
	2	3	5.34	0.84			
PalmStrength_M1	1	3	46.00	25.12	-.421	4	.695
	2	3	52.67	11.02			
PalmStrength_M2	1	3	35.00	13.23	-.149	4	.889
	2	3	36.33	8.08			

Table 3. Independent sample t-test between medium and hard ball conditions

	Group	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)
ThrowSpeedMax_M1	2	3	82.58	5.51	.187	4	.861
	3	3	81.02	13.42			
ThrowSpeedMin_M1	2	3	5.68	0.88	.463	4	.667
	3	3	5.36	0.81			
ThrowSpeedMax_M2	2	3	86.60	10.31	1.015	4	.368
	3	3	80.40	2.35			
ThrowSpeedMin_M2	2	3	5.34	0.84	1.352	4	.248
	3	3	4.27	1.07			
PalmStrength_M1	2	3	52.67	11.02	.054	4	.959
	3	3	52.00	18.19			
PalmStrength_M2	2	3	36.33	8.08	-.537	4	.620
	3	3	40.33	10.07			

Table 4. Independent sample t-test between soft and hard ball conditions

	Group	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)
ThrowSpeedMax_M1	1	3	84.65	4.30	.447	4	.678
	3	3	81.02	13.42			
ThrowSpeedMin_M1	1	3	5.07	1.39	-.318	4	.766
	3	3	5.36	0.81			
ThrowSpeedMax_M2	1	3	87.01	2.77	3.150	4	.035
	3	3	80.40	2.35			
ThrowSpeedMin_M2	1	3	5.34	1.43	1.030	4	.361
	3	3	4.27	1.07			
PalmStrength_M1	1	3	46.00	25.12	-.335	4	.754
	3	3	52.00	18.19			
PalmStrength_M2	1	3	35.00	13.23	-.556	4	.608
	3	3	40,33	10,07			

DISCUSSION

This study investigated the influence of ball elasticity on throwing speed and palmar strength in female handball players, offering insights into performance parameters under varying conditions. The results contribute to understanding the interplay between equipment characteristics, athletic performance, and fatigue, providing a foundation for further investigation.

The analysis of throwing speed, encompassing both maximum and minimum values, revealed no statistically significant differences between pre-exercise (M1) and post-exercise (M2) measurements (e.g., for ThrowSpeedMax: M1 Mean = 82.75, SD = 7.73; M2 Mean = 84.67, SD = 6.34). These results indicate that the specific exercise protocol did not adversely affect throwing speed, suggesting that well-trained athletes possess adaptations that mitigate the impact of short-term fatigue. This aligns with studies such as those by Raeder et al. (2015).

In contrast, a significant reduction in palmar strength was observed following the exercise protocol (M1 Mean = 50.22, SD = 16.76; M2 Mean = 37.22, SD = 9.55). This outcome underscores the effectiveness of the protocol in inducing muscle fatigue, particularly in the muscles responsible for grip strength. Similar findings were reported by Jöris et al. (1985) and Tuquet et al. (2020), who observed declines in grip strength following high-intensity handgrip exercises in athletes. This reduction emphasizes the importance of recovery strategies and targeted strength training to enhance grip endurance.

The study compared soft, medium, and hard ball conditions, revealing no statistically significant differences in most parameters across the groups (e.g., ThrowSpeedMax_M1; PalmarStrength_M1). These findings suggest that ball elasticity does not play a dominant role in influencing throwing speed or grip strength during standard conditions. Consistent with the work of Manchado et al. (2020), external equipment factors like ball elasticity may have a smaller effect compared to biomechanical and physiological variables intrinsic to the athlete.

Interestingly, a significant difference was observed in ThrowSpeedMax_M2 when comparing soft and hard balls (Soft Mean = 87.01, SD = 2.77; Hard Mean = 80.40, SD = 2.35). This finding suggests a nuanced interaction between ball elasticity and muscle fatigue, potentially due to differences in energy transfer and grip dynamics. It aligns with studies by Mascarin et al. (2017), which emphasize the importance of equipment properties in specific performance scenarios. The interaction between fatigue and ball characteristics warrants further exploration to determine its implications for match play and injury prevention.

These findings provide valuable insights for optimizing training and equipment in handball. Coaches should prioritize grip-specific endurance training and recovery strategies to address fatigue-related declines in performance. While ball elasticity had limited impact under standard conditions, its role in fatigue scenarios suggests that equipment design could be tailored to support athletes during extended play.

Future research should expand the sample size and investigate the biomechanical and neuromuscular mechanisms underlying these interactions. Incorporating advanced technologies such as motion capture and electromyography could provide a deeper understanding of how ball elasticity influences performance. Additionally, longitudinal studies could explore the long-term effects of training with different ball types on athlete development and injury risk.

This study highlights that while ball elasticity has minimal impact on throwing speed and grip strength under standard conditions, its influence becomes significant under fatigue. These findings contribute to a nuanced understanding of performance determinants in handball and underscore the importance of integrating equipment considerations into training and competition strategies.

CONCLUSION

In conclusion, the study's results shed light on the intricate interplay between ball elasticity, throwing speed, and palmar strength among female handball players. While the exercise protocol effectively induced muscle fatigue, it did not significantly impact throwing speed. Additionally, ball elasticity exhibited minimal influence on the parameters considered, with only a subtle differentiation observed between soft and hard balls in the context of post-exercise maximal throwing speed. These findings underscore the complexity of factors influencing handball performance and advocate for continued research to comprehensively understand the multifaceted nature of player dynamics.

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EFFECTS OF BASKETBALL-SPECIFIC HIGH-INTENSITY INTERVAL TRAINING ON AEROBIC CAPACITY IN ADOLESCENT FEMALE BASKETBALL PLAYERS

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ABSTRACT. Introduction: Basketball-specific high-intensity interval training (HIIT) has been documented to be a time-efficient, skill focused training method for enhancing the aerobic performance. The aim of this study was to investigate the effects of basketball-specific HIIT on aerobic capacity in adolescent female basketball players. **Materials and methods:** Participants were 16 female basketball players, aged 13-15 years. They were equally and randomly divided into two groups: a control group and an experimental group. The subjects from the experimental group performed a basketball-specific HIIT protocol for 6 weeks (2 times per week, 25 minutes per session), before the basketball training. The control group followed a basketball training program for the same period, with the same frequency (2 times a week, 90 minutes per session). Pre- and post-intervention, the multi-stage fitness (beep) test was used to assess aerobic endurance. **Results:** After 12 training sessions, the experimental group showed a significant increase in test scores (p = .002, with a mean difference of 1.263). When compared to the control group, post-intervention, the experimental group showed significantly higher test scores

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(p < .001, with a mean difference of 1.69). The findings suggest that aerobic endurance increases in adolescent basketball athletes after 6 weeks of training. **Conclusion:** Basketball-specific HIIT appears to be a solid option for improving aerobic performance in adolescent female players while maintaining focus on basketball skills.

Keywords: *basketball drills, aerobic performance, multi-stage fitness test, adolescent females*

INTRODUCTION

Basketball is a court-based team sport requiring players to exert high-intensity effort interspersed with low- to moderate-intensity effort (Stojanović et al., 2018). Characterized by frequent changes in movements due to repeated transitions between offence and defence, the basketball game is physically demanding to the extent that both aerobic and anaerobic energy systems are used during matches (García et al., 2020; Stojanović et al., 2018). Throughout a match, basketball players must jump, sprint, accelerate, decelerate, and change directions, activities which emphasize the need to achieve a physical fitness level that allows them to perform maximal efforts (García et al., 2020; Heishman et al., 2020; Hernández et al., 2018; Stojanović et al., 2018).

Aerobic endurance, along with other key physical fitness components, is essential for athletes' ability to execute basketball skills and enhance their overall gameplay (Aschendorf et al., 2019). In young elite basketball players, physical match performance (i.e., distance travelled in high-intensity shuffle) and aerobic capacity (i.e., VO_{2max}) were proved to be correlated (Aschendorf et al., 2019; Ben Abdelkrim et al., 2007; Narazaki et al., 2009). Overall, a higher level of aerobic performance enhances the athlete's capacity to frequently carry out high-intensity actions during a basketball game and to recover from high-intensity effort (Aschendorf et al., 2019).

Proved to positively affect both the metabolic and cardiovascular functions of athletes, high-intensity interval training (HIIT) is defined as a training method that alternates bouts of strenuous exercise with recovery periods (Deak & Boros-Balint, 2017; Stankovic et al., 2023). When compared to alternative training programs, HIIT was found to improve to a greater degree the aerobic and anaerobic capacity of young athletes (Engel et al., 2018). A systematic review and meta-analysis reported that running-based HIIT had significantly better benefits on soccer players' sprinting time than small-sided games (Clemente et al., 2021). Regarding the improvement of endurance

performance and VO_{2max} in male and female youth and adult soccer players, the findings of Clemente et al. (2023) suggest similar effects generated by both running-based HIIT and small-sided games. Comparable results were reported by Delextrat et al. (2018) in elite junior basketball players. Similarly enhanced aerobic fitness, anaerobic capacity and muscle oxygenation during repeated sprint were observed after 6 weeks of different training interventions (i.e., HIIT and small-sided games, respectively) (Delextrat et al., 2018). A recent study evaluated the effectiveness of HIIT on the aerobic capacity and sport-specific skills in basketball players. After 5 weeks (10 sessions) of HIIT, significant increases were reported in VO_{2max}, control dribble, passing skills, lower body power and shooting skills in the experimental group (Kumari et al., 2023).

Although there is solid evidence regarding the benefits of HIIT on the physical performance of male team sport athletes, there are insufficient results to conclude about the effects of HIIT in female team sport athletes (Stankovic et al., 2023). The existing studies indicate that HIIT had a significant positive effect on VO_{2max}, repeated sprint ability, change of direction speed, speed, and explosive strength of the lower limbs in female athletes who are involved in team sports, regardless of the training level or competitive experience (Stankovic et al., 2023). 5 weeks (2 training sessions per week) of basketball-specific HIIT, with short and long intervals, were sufficient to increase the aerobic performance in youth female basketball players with no adverse effects on power-related performances (Aschendorf et al., 2019). After 6 weeks (2 training sessions per week) of HIIT, the aerobic performance of regional-level U19 female basketball players improved in both experimental groups (i.e., cardiopulmonary-based HIIT and neuromuscular-based HIIT, respectively) (Rodríguez-Fernández et al., 2023).

The aim of this study was to investigate the effects of basketball-specific HIIT on aerobic capacity in adolescent female basketball players. We hypothesized that 6 weeks (2 training sessions per week) of HIIT using basketball-specific drills would generate positive effects on aerobic performance in young female basketball athletes.

MATERIALS AND METHODS

Subjects

The study included 16 female basketball players aged 13-15 years. All participants were actively competing in the Romanian National Championship for their age category. The subjects were randomly divided into two groups: the experimental group (EG, $n = 8$) and the control group (CG, $n = 8$).

The mean height of the experimental group was 164.48 cm (*SD* = 3.02), while the control group had a slightly greater mean height of 169.09 cm (*SD* = 5.33).

In terms of weight, the experimental group had a mean of 51.15 kg (*SD* = 3.43), whereas the control group had a higher mean weight of 58.91 kg (*SD* = 9.70). The sample consisted of trained athletes, ensuring a competitive and homogenous population for the study.

Ethical approval for this study was obtained from the ethics committee of the Faculty of Physical Education and Sport, Babeş-Bolyai University, ensuring compliance with ethical research guidelines. Prior to participation, all subjects and their legal guardians provided written informed consent, acknowledging their voluntary participation in the study. Participants were fully informed about the purpose, procedures, and potential risks involved. They were also made aware of their rights, including the option to withdraw from the study at any time without any consequences. Confidentiality and anonymity of the data were maintained, with all personal information securely stored and used solely for research purposes. The study adhered to ethical principles regarding research with human subjects, ensuring respect for participants' autonomy and well-being.

Testing procedures

Aerobic capacity was assessed using the multi-stage fitness (beep) test (Léger & Lambert, 1982), a widely used field test for estimating cardiorespiratory endurance. Participants performed the test in groups, running back and forth between two lines placed 20 meters apart at increasing speeds dictated by audio signals. If a participant failed to reach the line before the beep, they received a warning; the test ended when they could no longer keep pace. Baseline testing was conducted before the training intervention, and post-testing was performed at the end of the training period.

Training intervention

The intervention lasted six weeks, with HIIT sessions conducted twice per week (Mondays and Wednesdays) in addition to regular basketball training. The HIIT protocol was integrated into the warm-up phase of the basketball practice and was designed to enhance aerobic capacity while incorporating basketball-specific skills.

Each HIIT session consisted of:

- Work-to-rest ratio: 45 seconds of high-intensity effort followed by 30 seconds of active recovery.

- Training structure: 4 sets with varying series (3, 2, 2, and 4 repetitions per set).
- Rest intervals: 3-minute passive recovery between sets.

Exercise protocol

The HIIT training sessions incorporated a variety of basketball-specific exercises designed to enhance both aerobic capacity and technical skills. The Monday sessions focused on dribbling and agility, beginning with high-intensity cross-over dribbles, behind-the-back dribbles, and dribbling between the legs. These were followed by more complex movements such as lunges combined with dribbling under the front leg and controlled dribbling from a lunge position, challenging both coordination and endurance. To further develop lower-body power, the sessions included vertical jumps, with and without trunk rotation, ensuring explosive movement patterns were reinforced. Footwork and agility were also emphasized through lateral movements, including side steps in an "X" pattern and quick lateral shuffles, helping players improve their defensive and transition movements.

The Wednesday sessions shifted the focus toward running endurance while integrating basketball dribbling. Participants performed repeated bouts of submaximal running with dribbling, pushing their aerobic capacity while maintaining ball control. These high-intensity efforts were alternated with light jogging to allow for active recovery while keeping players engaged in continuous movement. By integrating technical dribbling elements with sprint-based conditioning, the HIIT program provided a sport-specific approach to improving cardiovascular endurance while reinforcing essential basketball skills.

To ensure the safety of participants, participants' perceived exertion and ability to maintain intensity were observed, with improvements noted after approximately four weeks.

Control group protocol

Participants in the control group followed their standard basketball training program three times per week, without additional HIIT sessions. Their training focused on technical and tactical basketball drills without structured aerobic conditioning beyond regular practice.

This methodological approach allowed for the evaluation of the effects of HIIT on aerobic endurance while maintaining ecological validity by integrating training within a basketball-specific context.

Statistical analyses

All statistical analyses were performed using SPSS statistics for Windows, version 17.0b. Continuous variables were defined by the mean ± standard deviation (SD). Shapiro-Wilk test was used for determination of normal distribution. To assess the intervention's effects, a paired-sample *t*-test was used to compare pre- and post-training results within each group, while an independent-sample t-test was applied to examine differences between the experimental and control groups. A p value of < 0.05 was considered statistically significant.

RESULTS

The assumption of normality was assessed using the Shapiro-Wilk test. Results indicated that all four datasets were normally distributed: BeepTest_EG_M1, $W(8) = 0.902$, $p = .169$; BeepTest_EG_M2, $W(8) = 0.939$, $p = .287$; BeepTest_CG_M1, $W(8) = 0.967$, $p = .728$; and BeepTest_CG_M2, $W(8) = 0.952$, $p = .532$. As all p values exceeded the .05 significance threshold, the null hypothesis of normality was not rejected, supporting the assumption that the data follows a normal distribution.

Since the Shapiro-Wilk test indicated that all datasets were normally distributed ($p > .05$), parametric tests could be appropriately applied to compare the data. A paired samples *t*-test was used to assess within-group differences over time, as it is suitable for comparing two related measurements from the same participants. Additionally, an independent samples *t*-test was conducted to compare the mean differences between the experimental and control groups at each measurement point. Normality assumption ensures the validity of these statistical tests, allowing for reliable inference about group differences and intervention effects.

Table 1. Paired sample *t*-test results between the initial (M1) and final measurements (M2) for both the experimental (BeepTest_EG) and control groups (BeepTest_CG) of the beep test

		N	Mean	Std. Deviation	Mean Difference	t	df	p (95%)
Pair 1	BeepTest_EG_M2	8	6.61	0.56	1.263	4.690	7	.002
	BeepTest_EG_M1	8	5.35	0.94				
Pair 2	BeepTest_CG_M2	8	4.93	0.56	.337	4.621	7	.002
	BeepTest_CG_M1	8	4.59	0.54				

A paired samples *t*-test was conducted to compare the Beep Test performance before and after the intervention for both the experimental and control groups. Results indicated a significant increase in performance for the experimental group from pre-test (BeepTest_EG_M1) (M = 5.35, SD = 0.94) to post-test (BeepTest_EG_M2) (M = 6.61, SD = 0.56), t (7) = 4.690, p = .002, with a mean difference of 1.263 (Table 1).

Similarly, the control group also demonstrated significant improvement from pre-test (BeepTest_CG_M1) (M = 4.59, SD = 0.54) to post-test (BeepTest_CG_M2) (M = 4.93, SD = 0.56), t(7) = 4.621, p = .002, with a mean difference of 0.337 (Table 1).

These findings suggest that both groups improved their performance over time, with a larger improvement observed in the experimental group.

Table 2. Independent sample *t*-test results between the experimental (BeepTest_EG) and control groups (BeepTest_CG) for both the initial (M1) and final measurements (M2) of the beep test

		N	Mean	Std. Deviation	Mean Difference	t	df	p (95%)
M1	BeepTest_EG	8	5.35	0.94	0.76	1.989	14	.067
	BeepTest_CG	8	4.59	0.54				
M2	BeepTest_EG	8	6.61	0.56	1.69	6.004	14	.000
	BeepTest_CG	8	4.93	0.56				

An independent samples *t*-test was conducted to compare the Beep Test scores between the experimental (EG) and control groups (CG) at both measurement points. At baseline (M1), the difference between EG (M = 5.35, SD = 0.94) and CG (M = 4.59, SD = 0.54) was not statistically significant, $t(14) = 1.989$, $p = .067$, though EG had a higher mean score (mean difference = 0.76) (Table 2). However, at post-test (M2), EG (M = 6.61, SD = 0.56) demonstrated significantly higher scores compared to CG (M = 4.93, SD = 0.56), $t(14) = 6.004$, $p < .001$, with a mean difference of 1.69 (Table 2). These results suggest that while the two groups started with relatively similar performance levels, the experimental group showed a significantly greater improvement following the intervention.

DISCUSSION

Recognized as one of the most effective methods of improving cardiorespiratory and metabolic function in both trained and untrained individuals, HIIT implies repeated short (< 45 s) to long (2-4 min) bouts of strenuous exercise intercalated with recovery periods (Buchheit & Laursen, 2013; Buchheit & Laursen, 2013a; Deak & Boros-Balint, 2017). In team sports, HIIT is used as an alternative, time-efficient training technique, to continuous low-intensity running protocols for enhancing aerobic fitness (Buchheit & Laursen, 2013; Buchheit & Laursen, 2013a; Rodríguez-Fernández et al., 2023). HIIT was also proved to be successful as a means of increasing skill-related performance in team sports (Stankovic et al., 2023).

Numerous studies published in the last decade investigated the effects of different variations of HIIT on cardiovascular fitness in basketball players. The reported findings indicated that aerobic capacity significantly improved in both male and female athletes (Arslan et al., 2022; Aschendorf et al., 2019; Delextrat et al., 2018; Delextrat & Martinez, 2014; Fang & Jiang, 2024; Gantois et al., 2019; Kumari et al., 2023; Mourgan et al., 2024; Rodríguez-Fernández et al., 2023; Sanchez-Sanchez et al., 2018; Smith et al., 2022; Song et al., 2023; Zeng et al., 2022).

When compared to small-sided games training (SSG), HIIT elicited similar positive physical adaptations in adolescent male basketball players (Arslan et al., 2022; Delextrat et al., 2018; Delextrat & Martinez, 2014). After 6 weeks, greater improvements were observed in 30 meters sprint time in the HIIT group, while the SSG group induced significantly higher technical skills such as control dribbling and shooting skills (Arslan et al., 2022). The results reported by Delextrat and Martinez (2014) imply that both interventions (i.e., HIIT and SSG, respectively) enhanced aerobic capacity in male junior basketball players, with the difference that the SSG group showed greater improvements in defensive agility, shooting skills, and upper body power. In elite male junior basketball players, after 6 weeks of training, aerobic endurance, anaerobic power, and muscle oxygenation capacity significantly increased in both HIIT and SSG groups (Delextrat et al., 2018).

Aerobic performance improved in young female basketball athletes after 5 weeks of basketball-specific HIIT (Aschendorf et al., 2019; Mourgan et al., 2024), after 6 weeks of HIIT with one and three changes of direction (Sanchez-Sanchez et al., 2018), after 6 weeks of cardiopulmonary- and neuromuscular-based HIIT (Rodríguez-Fernández et al., 2023), and after 4 weeks of SSG and HIIT with changes of direction (Zeng et al., 2022). A study compared the effects of short sprint interval training on male and female

basketball players' aerobic endurance and anaerobic power (Fang & Jiang, 2024). The conclusion was that males and females equally gained from the integration of short sprint interval training into their basketball-specific training regime (Fang & Jiang, 2024).

Since evidence regarding the benefits of incorporating HIIT into the training program of young female basketball players is scarce, the current study was aimed at investigating the effects of basketball-specific HIIT on aerobic capacity in adolescent female basketball players. The results showed a significantly greater improvement in post-intervention scores of the multi-stage fitness (beep) test in the experimental group compared to the control group. These results align with the findings of studies which used basketball-specific HIIT as a method to positively impact aerobic endurance (Aschendorf et al., 2019; Mourgan et al., 2024). Although VO_{2max} was not measured directly in a laboratory setting due to practical reasons, the use of field tests as a valid alternative to estimate aerobic capacity is widely accepted (Batista et al., 2017). The multi-stage fitness test, also known as the 20-meter shuttle run test, or as the beep test, was found to be the most appropriate to evaluate the cardiorespiratory fitness of young people (Batista et al., 2017). In intermittent team sports (e.g., soccer, basketball etc.), the beep test and the Yo-Yo intermittent recovery test are used with similar results in assessing aerobic endurance (Berdejo-del-Fresno & González-Ravé, 2013; Gabryś et al., 2019).

Game performance is influenced not only by the physical fitness of athletes, but also by other important factors such as tactical and technical skills. SSG is known to be highly sport specific due to its integration of movements and tasks distinctly associated with a certain sport. The effectiveness of SSG with regards to improvements in aerobic endurance is generally acknowledged (Arslan et al., 2022; Clemente et al., 2023; Delextrat et al., 2018; Delextrat & Martinez, 2014; Zeng et al., 2022). Likewise, the training protocol designed for this study contained dribbling drills, sideway shuffling movements, change of directions, and jumps, which seem to occur often during basketball games (Ben Abdelkrim et al., 2007), executed in short intervals (45 seconds) with high intensity. Thus, basketball-specific HIIT appears to be a solid option for increasing aerobic performance while maintaining focus on basketball skills.

CONCLUSION

A court-based intermittent team sport, basketball is characterized by frequent changes in movements due to repeated transitions between offence and defence. Due to the physical, technical and tactical requirements of the

basketball game, athletes must achieve a physical fitness level that allows them to perform maximal efforts. Time-efficient and focused on basketball skills, basketball-specific HIIT can be carried out to improve aerobic performance in adolescent female players.

Conflict of interests

The authors declare that there is no conflict of interest in this research.

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THE LEVEL OF MUSCULOSKELETAL FITNESS OF MALE PUPILS (9-11) YEARS IN A SAMPLE OF ALGERIAN PRIMARY SCHOOL CHILDREN

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ABSTRACT. This study aimed to identify the level of musculoskeletal fitness of male students 9-11 For this purpose, the researchers used the descriptive method on a randomly selected sample of 750 pupils from the primary education stage in schools in the state of Oran. For the purpose of this study, the researchers used three tests, namely the basketball throwing test from a long sitting position to measure muscular strength, the sitting test from the knees with bent knees 60 seconds to measure muscular endurance, and the trunk forward flexion test from a standing position on the box to measure flexibility. After analysing the obtained results, the researchers concluded that the level of musculoskeletal fitness components was low, and this decrease was not equal in all musculoskeletal fitness components, as the decrease in muscular endurance, flexibility, and muscular strength component was better compared to previous studies. In addition, there were statistically significant differences in the musculoskeletal fitness components according to the age variable, in favour of the age group 9 years in the flexibility variable, in favour of the age group 10 years in the (muscular endurance) variable and in favour of the age group 11 years in the muscular strength variable.

Keywords: *Physical fitness, musculoskeletal fitness, primary school.*

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INTRODUCTION

The current time is characterized by a technological revolution that has brought about a significant change in the world in the lifestyle and behavior of food and living. His use of transportation and the electric elevator in most of his movements instead of walking, climbing stairs and sitting for long hours in front of the television and computer has reduced his movement and reflected negatively on his health with the spread of lethargy, which has become predominantly of the nature of lack of movement, causing the emergence of many diseases.

In this regard, the mufti of Ibrahim points out that the modern era was characterized by growing scientific discoveries that provided all the tools and devices made by advanced technology that enabled man to end almost all his daily life activities without much physical effort. The tools and devices also interfered in every work performed by man today in his daily life, which explains the very big difference between what man was doing yesterday and man today in terms of physical effort (Marwan, 2004). Movement and activity. What increased the situation was the clear and scandalous impact on the lifestyle of young children who are in the construction stage, so inactivity and lack of movement was the lion's share in enabling them to stagnate in their various movements from running and jumping to sitting in front of video games and just pressing buttons.

In order to maintain the health of the rising generation, it is necessary to focus on physical fitness, which is the cornerstone of physical activity, which is one of the basic components of the health of the individual in order to enable him to perform the requirements of life and its functions to the fullest, as well as its direct correlation with personal health and proper texture (Yazid, 2001).

Experiments, bodies and the world health organization have also proven that lack of physical activity and movement in daily life is accompanied by many non-communicable diseases, such as cardiovascular diseases, hypertension, obesity and other diseases, and this is confirmed by the American college of sports medicine (Pate, 1995; Hazaa, 2004).

Physical education and sports have a great role in maintaining human safety and health, as confirmed by several studies and research that sport is a means of prevention, treatment and adaptation, in addition to being the best and most economical way to acquire and maintain health (Abdelwaheb, 1995).

Therefore, we find that encouraging the practice of sports in developed countries is no longer limited to athletes only, but has extended to become the subject of interest by those interested in health, doctors, medical and sports workers, and the subject of fitness has become an obsession for many of them.

Therefore Moh, Hasanin, & Abou Ali (2005), many countries and governments have tended to raise the level of fitness related to health in order to prepare a generation that enjoys activity and good health, hence the need to practice physical activity for the purpose of health (Abou, 2011).

Having a minimum level of health-related fitness is important to achieve the prevention of some diseases related to the performance of efficient movement and physical effort and to reach a state of health advancement (Mofti, 2019).

From the above, the extent of the close relationship between the level of both health and fitness is clear. Health-related fitness has several elements that can be measured and developed. It is mentioned Ortega (2008) that fitness is an important indicator of health in children and adolescents. Health-related fitness includes physical formation, cardiorespiratory fitness, and musculoskeletal fitness.

Several studies have shown that each of the components of fitness has a positive effect on health (Garcia-Hermoso, Correa-Bautista, Olloquequi, & Ramirez-Vélez, 2018; Smith, Eather, Morgan, & Plotnikof, 2014). Musculoskeletal fitness is one of the elements of health-related fitness, and its importance lies in raising the efficiency of the body's functional capabilities. High levels of its elements are related to the ability to accomplish daily tasks, the ability to move around, and the improvement of lifestyle in general. Improving musculoskeletal fitness also positively affects the cardiovascular system and musculoskeletal metabolism, which are muscle strength, muscular endurance, and flexibility (Kell et al, 2001).

Muscular strength is one of the health-related fitness components that can be defined as the maximum amount of force that can be generated by single or group of muscles in one contraction (Frontera et al., 2006). Muscular strength is important for everyone, it allows us to perform endless activities and tasks in our life (any physical action needs strength) thus, living well and independently (Barker, 2004; Dahoune et al, 2018). Because of its important role in life, muscular strength testing is administered. There are numerous fitness test batteries assessing health-related fitness.

Muscle strength is related to the general health of the individual, as it works to develop the muscular tone of the body (Terry-Ann & Werner, 2003). However, muscle strength is one of the most important elements of fitness related to health, especially in the elderly community. Muscle strength helps to live independently without the help of others, and muscle strength has a positive impact on the quality of life, and when muscle strength increases, it increases the ability to move and increases the ability to enjoy life (Alourfi, 2023).

Muscle endurance is also the second element of fitness, whether in terms of health or in terms of its association with sports competitions, as it plays a role

in reducing exposure to heart and circulatory diseases by improving high-density lipoproteins (HDL) and reducing cholesterol. It also increases the strength of bones, ligaments and tendons, as it works to increase the percentage of net muscle weight with some simple changes in body measurements (Abou, 2011).

He points Alalaia (2012) out that flexibility is an essential element of physical fitness as it allows the athlete to perform sports movements in an economically feasible manner, which is a mobility through which the individual can perform various movements in a large and wide range. Flexibility, along with other physical traits, forms the pillars on which the rapid acquisition and mastery of motor performance is based, in addition to helping to avoid injury (Bakir, 2011).

Through the experience of researchers in the sports fields and their active follow-up of the reality of physical activity in children, it was noted the lack and decline in the level of the elements of musculoskeletal fitness and the rapid fatigue of students, and the interest of many researchers in studying this matter, which is to know the level of physical fitness associated with health among various groups of society in some Arab and foreign countries, such as a study in Vanhelst et al (2020) addition to Rached (2022) and El Rashidi (2021) studying, studying Zahi (2020) and studying El Halama (2020), and given the scarcity of research that was concerned in its study with the level of the elements of musculoskeletal fitness in Algerian society, there are still no studies that measure the level of musculoskeletal fitness of primary school students in Algeria in general, and male students 9-11 years in the primary stage in the state of ORAN in particular. To fill this gap in the research, this study aimed to explore the relationship between students' PF levels and the, and musculoskeletal fitness in Algeria primary schools. It can be hypothesized that better musculoskeletal fitness could be associated with high levels of motivation and Algeria children and demographic characteristics (e.g., grade, ethnicity, parent education, and BMI) affect musculoskeletal fitness. The knowledge gained through this study may facilitate the development of health promotion policies and programs for Algerian children.

MATERIALS AND METHODS

1. Study Design and Participants

The researchers used the descriptive approach in the survey method to suit the study and to achieve its objectives.

The study population consists of all male pupils of the third stage of primary education (fifth year) in the schools of the state of Oran for the age group 9-11 years in the academic year 2023-2024.

2. Procedure

The study sample included 750 primary school students in the schools of Oran state who were randomly selected from the study population.

3. Assessments

3.1. Independent Variable (Musculoskeletal Fitness)

All the assessments were examined by the trained assessors. The data were collected via the annual tests of physical fitness that were conducted during class hours, and the tests were compulsory, as provided by Algeria's Ministry of Education. In addition, the components of Musculoskeletal Fitness were evaluated via the following tests with the revised 2021 version of the Algerian National Student Musculoskeletal Fitness Standard (CNSPFS) battery (Dahoun,2021). Which was both valid and reliable in assessing the eight main components of physical fitness. It is reliable and effective to use these test items to measure the Musculoskeletal Fitness of Algerian teenagers. The test-retest reliability achieved for all the assessments conducted in the current study was an ICC (intra-class correlation coefficient) > 0.85, and the result was generally acceptable. The surrogate assessment of body composition is BMI, which measures not only the height (cm) of the participants within 0.1 cm but also the weight (kg) within 0.1 kg through GMCS-IV, Jianmin, Beijing, China. During the anthropometric measurements, children were barefoot in light clothes. The BMI scores are obtained by the weight in kilograms divided by the squared height in meters kg/m^2. BMI = weight kg/height m^2. By following the procedure of the International Standards for Anthropometric Assessments (ISAK), two readings were recorded for every measurement, and a third reading was recorded if the difference was greater than 10% (Belhaidas,2021). The final results were obtained by working out the average value of the readings.

3.2. Muscular Strength

Muscular strength was examined by organising a seated basketball shooting exercise.

Starting from the wall, a 10-metre tape measure is fixed to the floor, and the pupil sits on the floor with his/her back to the wall.

The buttocks, back, shoulders and head should remain in contact with the wall, and the legs should remain straight with the feet closed (no space between the feet).

The pupil assumes a basketball chest pass position with the elbow touching the wall and then tries to pass the chest to achieve the longest possible distance.

The distance achieved is measured in centimeters when the basketball first touches the floor. Each student makes two attempts.

The longest distance is recorded in meters (Belaidas et al, 2021).

3.3. Muscular endurance

Second test: Sit-ups with knees bent (count) 60 seconds.

Test objective: To measure abdominal muscle strength and endurance.

The subject lies on his/her back on the foam mattress, with knees bent at an angle of approximately 80 degrees, feet close together, hands placed on the chest and crossed fingers of the right hand towards the left shoulder, and vice versa.

Another colleague stabilizes the feet by gently squeezing them with the hand (not the knee).

Scoring: The score is recorded by counting the number of correct repetitions. Sitting and lying down are counted as one complete attempt, and so on.

3.4. Flexibility

Based on the result of the sit-and-reach test, the flexibility of the lower part of the body was measured (Zhu, 2017). Under the instructions, the participants sat down, and their knees were fully extended. Further, their feet were firmly placed against vertical support. Along a measuring line, they were requested to reach forward with their hands as far as possible. The best score of the two attempts was recorded (Corrected to 0.1 cm), (WTS-600, Jianmin, Beijing, China).

4. Controlling Variables

Demographic information on study participants' grades, gender, ethnicity, and parent's education levels was measured by a self-reported questionnaire. These demographic factors were treated as covariates in further statistical analysis.

5. Statistical Analysis

Table 1. Shows the statistical description in the basic variables under research for the research group, n= 1830

Statistical significance / Variables	Unit of measure-ment	Lower value 97	Largest value	Mean, arithmetic(al) (maths.)	Standard deviation (maths.)	Modulus of torsion = torsion modulus (mech.)	Flattening coefficient
Age	years	9.00	11.00	9.87	0.62	0.09	0.46
Height	cm	1.21	1.76	1.42	0.07	0.30	0.34
Weight	kilogram	20.00	78.00	36.09	8.58	1.44	2.55

It is clear from table no. 01 regarding the statistical description of the research sample in the basic variables under research that the data of the total research sample are moderate, non-dispersive and characterized by the normal distribution of the sample. It is clear that the torsion coefficient of the sample members is limited to 3, -3, which indicates the moderation of the distribution of the sample's variable data in a normal distribution.

Stability

The study tool was consistently verified by applying it to a sample of 10 students who were taken from the study population and excluded from entering the study sample by the test-retest method with a one-week time difference between the two applications (the first application and the second application).

The Pearson correlation coefficient was calculated between the two applications and on each of the tests for the elements of musculoskeletal fitness and table no. 02 shows this.

It is clear from table no. 2 that the value of the coefficients of the physical fitness tests is positive and statistically significant at the level of significance 0.05. The coefficients of consistency between 0.73 and 0.95 are greater than the value of Pearson's correlation coefficient 0.52, which indicates that the tests are statistically significant, that is, there is a correlation in the results of the pre and post tests, which confirms the stability of the tests used and thus the possibility of using them in the basic study.

Table 2. Shows Pearson correlation coefficient for tests of muscle fitness elements, exploratory sample, n=10

Indicators	Examinations	Mean		Standard deviation		Sample size	Degree of freedom n-1	Level of significance	Calculated t	Scheduling
		pre-assessment	post-assessment	pre-assessment	post-assessment					
muscle power	basketball throw from long sitting	319	318	27.26	24.40	10	9	0.05	0.95	0.52
muscular endurance	sitting from lying down with knees bent (60s)	19.9	19.9	2.38	1. 91				0.73	
flexibility	bend torso forward from standing position on box	-7	6-8	4.67	4.42				0.81	

Table 3. Shows the results of the correlation coefficient values (validity) between the two tests (pre-post) in the tests of musculoskeletal fitness

Indicators	Examinations	Calculated t	t√ = self-authenticity	Sample size	Degree of freedom n-1	Significance level	Scheduling
power muscularity	throwing a basketball from a long sitting position	0.95	0.97	10	9	0.05	0.52
muscular endurance	sitting from lying down with knees bent 60 seconds	0.73	0.85				
flexibility	bend torso forward from standing position on box	0.81	0.90				

Through table no. 4, it is clear that the value of the validity coefficient (coefficient of severity of correlation) calculated for the tests at the level of significance 0.05 and the degree of freedom n-1=9 ranged from 0.85 to 0.97, which is greater or equal to the tabular value 0.52, from which there is a statistical significance, meaning that the test is true to what it was developed to measure.

Objectivity: these tests used are standardized tests that have been used previously in previous and similar studies, in addition to being clear, easy, non-translatable and far from self-assessment, which indicates that they have high objectivity.

RESULTS

It is clear from table no. 5 that the general arithmetic mean of muscular strength was 341.51 cm with a standard deviation of 68.14. Among the age groups, the arithmetic mean of muscular strength was 9 years old 335.20 cm with a standard deviation of 64.88, while the arithmetic mean of muscular strength was 10 years old 339.88 cm with a standard deviation of 64.46, while the arithmetic mean of muscular strength was 11 years old 349.52 cm with a standard deviation of 74.12.

As shown in table no. 5, the general arithmetic mean of muscular endurance was 18.51 repetitions with a standard deviation of 3.48. Among the age groups, the arithmetic mean of muscular endurance was 9 years 17.69 repetitions with a standard deviation of 3.48, while the arithmetic mean of muscular endurance was (10) years 19.23 repetitions with a standard deviation of 3.23, while the arithmetic mean of muscular endurance was 11 years 18.51 and a standard deviation of (3.48).

It is clear from table no. 5 that the general arithmetic mean of flexibility was -13.97 cm with a standard deviation of 7.37. Among the age groups, the arithmetic mean of flexibility was for 9 years -9.94 cm with a standard deviation of 6.16.

While the arithmetic mean of elasticity was for 10 years -13.88 cm and with a standard deviation 6.72 while the arithmetic mean of elasticity was for 11 years -18.16 and with a standard deviation 6.82.

It is clear from table no. 6 of the variables under research according to the age of the research sample that there are statistically significant differences at the level of 0.05 in all variables, as the value of F calculated was greater than the value of the table at the level of 0.05.

It is clear from table no 6 of the toki s.d.h test at the level of 0.05 to determine the significance and direction of the differences in the extracted significant variables, and it is clear from the one-way variance analysis that there are differences between the age groups as follows:

- There are statistically significant differences in the variable of muscle strength in favor of the age group 11 years compared to the age groups 9-10 years, and there were also differences in favor of the age group 9 years on the age group 10 years.

- There are statistically significant differences in the muscular tolerance variable in favor of the age group 10 years compared to the age groups 9-11 years. There were also differences in favor of the age group 9 years compared to the age group 10 years.

- There are statistically significant differences in the variable of flexibility in favor of the age group 9 years compared to the age groups 10-11 years, and there were also differences in favor of the age group 10 years on the age group 11 years.

It is clear from tables no. 6 when comparing the differences in the statistical significance of the level of muscular strength between the categories 9-11 that there are statistically significant differences in favor of the age group 11 years, where the arithmetic mean was 349.52 cm, which is higher than the arithmetic mean of the age group 9-10 years, which was 335.20 - 339.88 cm, respectively. These results are consistent with the study of Ziada (2004); Hijazi (1987) and Zahi (2020) that muscular strength is at this age stage in favor of the elderly. The researchers attribute this result to the fact that muscle strength increases with age, and this is what indicated Abou Arida (1998) that the increase in muscle strength continues to increase with age to 25-30 and then begins to decline.

When comparing the differences in statistical significance in muscular endurance between the age groups 9-11 years, it is clear from tables no. 6 that there are statistically significant differences in favor of the age group 10 years, as the arithmetic mean was 19.22 repetitions, which is higher than the arithmetic mean of the age group 09-11 years, which was 17.68 - 18.65 repetitions, respectively. The researchers attribute the reason for the weak element of muscular endurance in the age group 9-11 years to the low element of flexibility, and this is consistent with what he indicated Kamel (2006) that one of the reasons for the weakness of the abdominal muscles and their endurance and the muscles behind the thighs is the result of low flexibility and the accumulation of fat between the muscles, tendons and joints that move and oppose the movement of the joint, as well as the lack of concentration often in the exercise necessary to develop the elements of physical fitness, in addition to the lack of exercise in sports and focus on the skill side.

With regard to comparing the differences in statistical significance in the level of flexibility between the age groups 9-11 years, through tables no. 6, it is clear that there are statistically significant differences in favor of the age group 9 years, where the arithmetic mean was -9.94 cm, which is higher than the arithmetic mean of the age group 10-11 years, which amounted to -13.88, -18.16 cm, respectively. This confirms Jamil el Ridi (2004) that the younger the player is, the more flexible he is in the joints than the big player. the researchers attribute the reason for the weak element of flexibility in the age group 10-11

years is that it is due to the ability to overcome external resistances due to their increased growth and large muscles, that is, the larger the muscle, the stronger it is and the less flexible it is, and this is what he pointed out Hassen (1978), and he adds that the age to the age of ten is equal to the muscular strength of males with females in the field, and when age increases, the rate of muscular strength in males increases very quickly. This is what the results of the study and the study agree with Hamed (2018).

In addition, flexibility, as Pnatt (1989) is considered one of the inherited physical abilities, has a tendency to decline to the lowest level during the age 10-12 years, while it improves and develops linearly towards adulthood. He points out AL-Hazaaa (2002) that there are other factors that influence how resilient individuals are, such as age, gender, body style, and training.

Table 4. Shows the arithmetic means and standard deviations of the level of performance of the test of the variables of musculoskeletal fitness among primary school students 9-11 years, n= 750 students.

Variables	Age	Sample	Arithmetic arithmetic	Standard deviation (maths.)	Less value	Biggest value
muscle power	09 years	254	335	88	180	600
	10 years	246	339	64	200	510
	11 years	250	349	74.12	170	600
	total	750	341	14	170	600
muscular endurance	09 years	254	17.69	3.48	10	29
	10 years	246	19.23	3.23	13	30
	11 years	250	18.65	3.55	10	29
	total	750	18.51	3.48	10	30
flexibility	09 years	254	-9.94	-16.6	-25	6
	10 years	246	13.88	6.72	-35	8
	11 years	250	18.16	6.82	-35	2
	total	750	97	7h 37m	-35	8

Table 5. Shows the statistical indications of the variables under consideration according to age, n= 750 pupils.

Statistical significance/ variables	Source of variance	Total squares	Degree of freedom	Squares mean	F value calculated	F value tabular	Level sig
muscle power	between groups	26818.57	2	13409.28	2.90	3.01	0.05
	within groups	3450978.90	747	78			
	total	3477797.47	749				

Statistical significance/ variables	Source of variance	Total squares	Degree of freedom	Squares mean	F value calculated	F value tabular	Level sig
muscular endurance	between groups	304	2	152	12.98	3.01	0.05
	within groups	78	747	11.74			
	total	37	749				
flexibility	between groups	11	2	05	98.65	3.01	0.05
	within groups	32204.41	747	43.11			
	total	40710.52	749				

* the value of (f) is significant at the level of (0,05).

Table 6. Shows the toki s.d.h test at the level of 0.05 to determine the significance and direction of differences in the significant variables extracted from the one-way variance analysis, n= 750 students.

Statistical significance variables	**Age**	**Mean, arithmetic(al) (maths.)**	**Significance of differences between averages**			
			10 years		**11 years**	
muscle power	09 years	335	681	722	323	.048
	10 years	339			642.0	0.255***
	11 years	349				
muscular endurance	09 years	685	543	0.001	967	0.005
	10 years	228			0.576	0.148
	11 years	652				
flexibility	09 years	945	937	0.001	215	0.001
	10 years	882			278	0.001
	11 years	160				

* moral at a level of significance less than 0.05.

DISCUSSION

The level of musculoskeletal fitness elements is low, and this decline was not equal in all elements of musculoskeletal fitness, as it shows a decrease in muscular endurance and flexibility, and the element of muscular strength was better compared to previous studies.

There are statistically significant differences in the elements of health-related fitness according to the age variable and in favor of the age group 9 years in the variable of flexibility and in favor of the age group 10 years in the variable muscular endurance and in favor of the age group 11 in the variable of muscular strength.

1. Study Strengths and Limitations

Firstly, the main strength of this study is that it utilized a relatively large sample size of 750 pupils for the first time to examine the relationship between physical fitness and musculoskeletal fitness in Algerian students during physical education. Secondly The results of the comprehensive muscular fitness test in this study, which was designed to assess Assessment of flexibility, strength endurance, muscular strength, vital capacity and body composition, were obtained from a standardized, nationally standardized test and are therefore highly reliable. III, Participants were enrolled through random sampling, which enhanced the validity of the study.

However, there are several limitations that should be recognized. Firstly, the cross-sectional design of the study may not satisfactorily explain causality. Consequently, prospective and experimental research designs should be adopted to understand the causal relationship between the causal relationship between adolescents and pupils' musculoskeletal fitness level. Second, as the PF evaluations were conducted in schools in an open-ended testing environment rather than in a laboratory setting, this may have influenced the accuracy of the results. This may have affected the accuracy of the results. The data collected in this study should be interpreted with caution. Thirdly, since the samples were collected from 15 schools for third-grade primary education (Year 5) in Beijing, they may not be fully representative of primary school students across the country. For this reason, the applicability of the findings in this study to a wider population is limited. Finally, there may have been some biases in the use of a questionnaire for data collection.

2. Practical Implications

The findings of this study have some practical implications for improving the physical well-being of Algerian students. Firstly, equal access to physical education apparatus for both boys and girls will be conducive to lessening the gender gap in physical fitness. Thus, creating a holistic educational environment involving inclusive and mindful teaching techniques will help to improve the general outcomes of physical activity for both genders. Secondly, it is arguable whether helping students achieve academic success or even giving students more validation of their academic achievements can positively influence their mental health and well-being. Thirdly, this study also highlights that helping students to maintain their BMI within a healthy range will be favorable to significantly improving their mental health. Possible methods to achieve this may include adding nutrition classes to the curriculum, teaching students about mindful eating, and incorporating more vegetables and proteins into school

meals. Indeed, any other practical recommendations aimed at improving either a student's physical or mental wellbeing are supported by the findings of this study, as the two have been verified to be closely correlated.

CONCLUSIONS

To conclude, this study has provided new insight into the relationship between musculoskeletal fitness and Physical Fitness in Algerian children, an issue that is rarely explored in academia in the public health field. Overall, this study has stressed the role of physical fitness in the well-being, motivation, and enjoyment of adolescents. Thus, it is essential to investigate whether the findings of this study can be reproduced in further studies of other population groups such as children, university students, and people from low- and middle-income countries. Apart from that, prospective and experimental research designs should be taken into account to better understand the causal association between PF and mental well-being.

Musculoskeletal fitness is an important and inadequately appreciated component of overall health and well-being. Wellness as it applies to strength and conditioning has numerous benefits. It allows maintenance of functional independence for longer periods in older adults. It impacts the metabolic capabilities of children and adults affecting the ability to maintain an ideal body weight. It has been shown to influence the prevalence and possibly the prevention of many musculoskeletal disorders such as muscle sprains, low back pain, osteoarthritis, osteoporosis, shoulder instability, and knee stability and pain. The current author summarizes the most recent recommendations for achievement and maintenance of musculoskeletal fitness for children and adults.

Author Contributions

Conceptualization, K.M., B.A. and M.M.; methodology, G.A. and B.A.; formal analysis, M.M. and G.A.; investigation, K.M., G.A. and M.M.; resources, B.A.; data curation, K.M.; writing-original draft preparation, K.M. and G.A.; writing—review and editing, M.M., K.M. and G.A.; visualization, M.M.; supervision, M.M.; project administration, G.A. and K.M. All authors have read and agreed to the published.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

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Conflicts of Interest

The authors declare no conflict of interest.

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INTRINSIC MOTIVATIONAL CLIMATE AND PHYSICAL ACTIVITY LEVELS OF FEMALE STUDENTS IN BUDAPEST, HUNGARY

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ABSTRACT. Motivation is a vital determinant in sustaining physical activity (PA). Motivation influences not only PA participation but also serves as a crucial determinant of exercise adherence. The study of motivational processes in sports for adolescents is crucial because, according to the World Health Organization, globally, 81% of adolescents aged 11-17 years were insufficiently physically active in 2022. The present research aimed to investigate a) the relationship of the variables of IMCPEQ [intrinsic motivational climate of PE lessons questionnaire] with PA of Hungarian female students and b) the differences concerning motivational components of students' PA. A sample of 325 Hungarian female students from nine schools aged 13–15 (mean age = 14.07; SD = 0.87) was used. They responded to the questionnaires online. Pearson correlation coefficient and one-way ANOVA were performed to identify the relationship and differences between variables. Findings indicated a significant positive relationship between PA levels and Task-involving climate, Social-relatedness supporting climate, Autonomy-supporting climate, Enjoyment, and Physical activity. No relationship was present between Ego/competitive climate variable and PA levels. Moreover, the intrinsic motivational climate in physical education (PE) significantly influenced differences in PA levels among female students. Post hoc test with Bonferroni corrections' results indicated significant differences in the variables. To summarize, IMCPEQ, as analysed by the Self-determination Theory and Achievement Goal Theory, encouraged physical activity.

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According to the study results and based on the higher mean of the task-involving climate, students' personal development, objectives, and expertise in skills should be emphasized.

Keywords: *Intrinsic Motivational Climate, Physical Activity Levels, female students in Budapest*

PREFACE

This study can be considered a continuation of the article published in the Hungarian Review of Sport Science (Ghazvini et al., 2024) since the processing of the topic differs only in that while the first one is Iranian, the latter presents the test results of Hungarian students. In itself, the separate analysis of the data of these two countries is an instructive scientific result, at the same time, according to our plans, in a future paper we will also compare the student data and examine their correlations.

INTRODUCTION

The World Health Organization (WHO) recommends at least 60 minutes of moderate to vigorous-intensity physical activity (PA) per day for children and adolescents aged 5 to 17 years (WHO, 2022). Nonetheless, 81% of adolescents globally, aged 11 to 17, were physically inactive. Adolescent girls were less active than adolescent boys, with 85% vs. 78% not meeting WHO recommendations of at least 60 minutes of moderate to vigorous intensity physical activity per day. Given the limited rate of physical activity observed among adolescents and the decline in activity levels compared with boys, there is a considerable focus on prioritizing the promotion of PA, especially aimed at girls (Camacho-Minano et al., 2011). The decline in physical activity is evident in both genders but becomes more apparent in girls and increases with age (Sherar et al., 2007). Diverse environments have been utilized to promote physical activity among youth; the most effective interventions have been implemented in the school environment (Edwardson et al., 2015). Physical education (PE) classes are frequently the initial exposure to PA for most children (Hoare and Somerset, 2018). School physical education substantially influences the development of a mindset conducive to enduring physical activity. This is because it is implemented

by qualified educators, who facilitate the development of consistent positive experiences of physical activity among the school-age population (Sallis et al., 2012).

Motivation is a primary important element associated with engagement in physical activities from the early years of life (Hagger & Chatzisarantis, 2007). Motivation is a cognitive process that initiates and sustains goal-directed behaviours (Pintrinch & Schunk, 2002). Motivation is the energy that motivates people to engage in physical or mental activities directed toward particular targets or objectives. The theoretical framework commonly employed to examine motivation in physical education comprises two principal theories: Self-determination Theory (Deci & Ryan, 1985) and Achievement goal Theory (Nicholls, 1989).

The self-determination theory posits that autonomy, competence, and relatedness are the essential variables of psychological well-being and effective functioning. Conditions that fulfil these three requirements positively influence well-being. In contrast, conditions that restrict or slow down the fulfilment of these needs can adversely affect people's behaviour and well-being. Each of these needs is fundamental, and failure to fulfil any of them may result in negative motivational outcomes (Deci & Ryan, 1985; 2000). In 1991, Deci and Ryan defined the need for autonomy as people's attempts to control their own behaviours. The need for competence was expressed as persons seeking to achieve a sense of efficacy. Finally, the need for relatedness was characterised as people's attempts to develop a satisfying and harmonious relationship with others.

Achievement goal theory (Nicholls, 1989) is another well-known theory in the field of research on motivational variables influencing children and adolescents. Achievement goal theory encompasses two goal perspectives: task (self-referenced) and ego (other-referenced), which are important in performance contexts. These orientations are related to the assessment of competence and success, and they are associated with significant behavioural variations (Nicholls, 1989).

Regarding the framework of Achievement goal Theory, the motivational climate is a vital element related to a situational psychological perception of the activity, guiding the objectives of action (Ames, 1992). The investigation of motivational climate's influence on physical activity in children and adolescents has been identified as one of the ten most significant research inquiries in physical education (Chen, 2013). The motivational climate in school physical education influences students' self-perception, motivation, and attitudes toward participation in PA. The social context established by significant people varies on the emphasised achievement goals (Duda & Balaguer, 2007). According to the scope of achievement

goal orientation, the motivational climate has two perspectives: a task-involving climate and an ego-involving climate. An ego-involving climate emphasises performance results and social comparisons among pupils. This results in heightened external motivation and anxiety, along with a reduced interest (Duda & Whitehead, 1998).

In a task-involving climate, students evaluate their performance based on personal development, receive praise for their efforts and attempts, and determine their objectives (Ames, 1992). Prior research has demonstrated that integrating Achievement goal Theory (Nicholls, 1989) with Self-determination Theory (Deci & Ryan, 1985) is beneficial for comprehending students' intra-individual motivation (Ciani et al., 2011; Ommundsen & Kvalø, 2007). Upon simultaneous examination of achievement goal theory and self-determination theory, it is apparent that they encompass analogous components, incorporating both social and cognitive dimensions. The principal distinction between the two theories is that the Achievement goal Theory functions solely with perceived competence, categorised into task-oriented and ego-oriented approaches. The Self-determination Theory encompasses the perception of competence, along with notions of autonomy and social relatedness as additional components.

Given the ongoing necessity to enhance the standards of physical education and develop relevant theoretical frameworks, it is crucial to evaluate attitudes towards the motivational climate within the physical education environment. Consequently, by concentrating on the Self-Determination Theory and Achievement Goal Theory, we wanted to examine the relationship between IMCPEQ variables with the physical activity levels of high school female students. Furthermore, we aimed to investigate differences in physical activity levels (low intensity, moderate intensity, and vigorous intensity) among female students and IMCPEQ variables.

METHODS

Participants and Procedures

The design was cross-sectional in the present study, carried out during the 2022-2023 academic year. Overall, the sample included 325 Hungarian female students aged 13 to 15 years old (M = 14.07; SD = 0.87). The participants were selected from nine schools that represented the wealthy, moderate-income, and low-income districts, and they were in Hungary and its suburbs. Mean height = 164.87 cm; Standard Deviation = 6.21 cm, Mean weight = 56.38 kg; Standard Deviation = 10.65 kg. 84.6% of Hungarian students lived with their

parents, with 40.6% part of four-member families. Furthermore, 92.6% had internet access via their cell phones. Regarding basic physical activity amenities, 79.4% had a garden at their home, 82.8% owned bicycles, 76.6% got skateboards, and 58.8% had skates. After receiving approval from the Hungarian University of Sports Science and the Ministry of Education in Hungary, the questionnaires were made available to volunteer students online with the endorsement of the school principals and consultation with physical education teachers. The questionnaires were translated from English to Hungarian by two professors who are experts in this subject. The Intrinsic Motivational Climate of PE Lessons Questionnaire (IMCPEQ), International Physical Activity Questionnaire (IPAQ), and General Information Demographic Data Questionnaire were completed by students online for approximately one hour. Additionally, the students were also assured that their responses would be kept confidential. For this study, an authorisation was issued from the research ethics committee of the Hungarian University of Sports Science, letter number TE-KEB/27/2022. Permission for the completion of all high school students was asked of the parents, and each participating student expressed his or her consent. Participation was entirely voluntary, and individuals had the option to withdraw from the study at any time and without explanation.

Measures

Intrinsic Motivational Climate of PE Lessons

Motivational climate was measured by using (IMCPEQ), which consists of 24 questions and four subscales: task- and ego-involving climate, autonomy support, and social relatedness. Additionally, it includes two variables, enjoyment and physical activity, which are not part of the motivational climate questionnaire (Soini et al., 2004). The ego-involving climate assesses the extent to which the class prioritizes social comparison, competition, and victory (four questions, e.g., "It is crucial for the students to outperform their peers"). The task -involving climate assesses the extent to which the physical education class prioritizes skill enhancement, effort, and self-improvement (five questions, e.g., "It is essential for students to strive to enhance their own skills"). The social relatedness assesses the extent to which students perceive a connection with their peers and teacher (four questions, e.g., "Our PE class exhibits a strong sense of unity"). The autonomy support assesses the extent to which students perceive they possess choices and control over their learning (five questions, e.g., "Students can influence the direction of PE lessons"). Each item was rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The IMCPEQ was translated

into Hungarian from English by two Professors who are experts in the sport psychology field. Moreover, Cronbach's alpha coefficients were between 0.78 and 0.88.

International Physical Activity Questionnaire

The IPAQ is a standardized self-report instrument developed in 1998 by an international group of researchers from several countries. The questionnaire has seen extensive usage in several studies, and its validity and reliability have been reported (Craig et al., 2003). This self-report questionnaire serves to provide a simple, reliable, and valid instrument for assessing the level of physical activity. The short form of the IPAQ is the abbreviation of the original long form of IPAQ. It contains seven questions that measure the frequency and duration of performing physical activity in three levels of intensity, such as walking, moderate-intensity, and vigorous-intensity activities. The types of activity assessed are walking, moderate-intensity activities, and vigorous-intensity activities; frequency is measured in days per week and duration in time per day for each of these specific types of activities. The components were aimed at providing separate scores for walking, moderate-intensity, and vigorous-intensity activity, as well as a combined total score to represent the overall level of activity. Add the frequency (days) and duration (in minutes) of walking, moderate-intensity, and vigorous-intensity activity to get the overall score. Respondents need to indicate the number of days per week and the minutes spent on each activity level. Another way to calculate the volume of activity is to weight each type of activity by its energy requirements as defined in METS (METs are multiples of resting metabolic rate), resulting in a score in MET-minutes. A MET-minute is calculated by multiplying the MET score by the number of minutes done. The following values will be used to analyse IPAQ data: walking = 3.3 METs, moderate PA = 4.0 METs, and vigorous PA = 8.0 METs. The questionnaire provides estimates of the overall physical activity in metabolic equivalent minutes per week, or MET min/week, and separately the time spent in each intensity level. During the calculation of the physical activity scores, only activities that lasted at least 10 minutes at a time were considered. Physical activities are classified into three levels of response: low, moderate, and vigorous. The algorithms for the classification of the data are defined in the scoring protocol (Guidelines for Data Processing and Analysis of the IPAQ 2005). Accordingly, participants will be categorized into three groups based on the total physical activity score: "Low" when the physical activity levels are below 600 MET-minute/week; "Moderate" from 600-3000 MET-minute/week; and "Vigorous" when above 3000 MET-minute/week.

Statistical Analyses

Data processing was performed using the software IBM SPSS v. 26. Descriptive statistic indicators were reported as frequencies, mean, and standard deviation. Pearson correlation coefficient and one-way ANOVA were performed to identify the relationship and differences between variables, respectively. Moreover, post hoc test with Bonferroni corrections was used to evaluate the differences between groups. Data analyses were made at a significance level of $P \leq 0.05$.

RESULTS

Table 1 showed measurements of minimum, maximum, mean, standard deviation, and variance of research variables, including PA levels, Ego/competitive climate, Task involving climate, social relatedness supporting climate, Autonomy supporting climate, Enjoyment, and Physical Activity.

Table 1. Measurements of minimum, maximum, means, standard deviations, and variance of PA levels and IMCPEQ's variables

	PA levels	Ego/ competi-tive climate	Task involving climate	Social related-ness support-ing climate	Autonomy supporting climate	Enjoy-ment	Physical activity
Minimum	1	1	1	1	1	1	1
Maximum	3	5	5	5	5	5	5
Mean	2.45	3.08	3.77	3.21	2.95	3.37	3.47
Std. Deviation	0.72	0.86	.086	1.02	0.95	1.13	1.03
Variance	.051	.075	.075	1.05	0.90	1.29	1.07

The analysis of students' physical activity levels showed that 58.2% engaged in vigorous exercise, 28.3% in moderate activity, and 13.5% in low activity (Table 2).

Table 2. Level of Physical Activity of female students

Physical Activity Level	Frequency	Percent
Low (<600 METmin/week)	44	13.5
Moderate (600-3000 METmin/week)	92	28.3
Vigorous (>3000 METmin/week)	189	58.2
Total	325	100

For the analysis of the relationship between the level of PA and variables related to IMCPEQ, Pearson's correlation coefficient was calculated (Table 3).

This means that all the variables in IMCPEQ were correlated with the PA level except the 'Ego' variable, which did not show any relation to the PA level. The correlation between the IMCPEQ variable and the variable PA levels was generally weak, but the task variable had a relatively stronger correlation. It is expected to get even stronger with a larger population.

Table 3. Correlation between PA levels (from IPAQ variables) and IMCPEQ's variables

	1	2	3	4	5	6	7
PA levels	--------						
Ego/competitive climate	0.09	--------					
Task involving climate	0.25**	0.39**	--------				
Social relatedness supporting climate	0.17**	0.05	0.42**	--------			
Autonomy supporting climate	0.14**	0.36**	0.53**	0.41**	--------		
Enjoyment	0.18**	0.20**	0.60**	0.42**	0.51**	--------	
Physical Activity	0.16**	0.29**	0.66**	0.35**	0.44**	0.60**	--------

** correlation is significant at the 0.01 level.

To compare the differences between students' levels of physical activity and the variables of IMCPEQ, One-way ANOVA was performed, as shown in Table 4. Significant differences in the levels of students' PA were influenced by the intrinsic motivational climate in PE.

Table 4. Results of One-way analysis of variance (ANOVA)

		Sum of Squares	df	Mean Square	F	Sig.
Ego/competitive climate	Between Groups	7.25	2	3.62	4.93	0.008
	Within Groups	236.74	322	0.73		
	Total	244.00	324			
Task involving climate	Between Groups	16.19	2	8.09	11.39	0.000
	Within Groups	228.90	322	0.71		
	Total	245.10	324			
Social relatedness supporting climate	Between Groups	10.31	2	5.15	5.00	0.007
	Within Groups	331.62	322	1.03		
	Total	341.93	324			
Autonomy supporting climate	Between Groups	10.42	2	5.21	5.95	0.003
	Within Groups	281.98	322	0.87		
	Total	292.41	324			
Enjoyment	Between Groups	17.94	2	8.97	7.18	0.001
	Within Groups	402.12	322	1.24		
	Total	420.07	324			
Physical activity	Between Groups	10.98	2	5.49	5.24	0.006
	Within Groups	337.26	322	1.04		
	Total	348.25	324			

Based on Table 5, there was a significant difference in the levels of physical activity among students and IMCPEQ's variables. With the purpose of identifying the groups to which these differences are significant, a post hoc test with Bonferroni corrections was adopted. These results are reported in Table 5. It can be seen that significant differences were found between moderate and vigorous levels of physical activity for the variables of ego, task, autonomy, enjoyment, and physical activity. In addition, there were also significant differences between low and vigorous levels of physical activity in the variables of task, social, enjoyment, and physical activity. With an increase in the sample size in the study, differences in all levels of physical activity are likely to be observed.

Table 5. Post hoc test with Bonferroni corrections' results for different levels of physical activity among students

	(I) PA levels	(J) PA levels	Mean difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Ego-competitive climate	Low activity levels	Moderate activity levels	0.26	0.15	0.274	-0.112	0.644
		Vigorous activity levels	-0.07	0.14	1.000	-0.420	0.270
	Moderate activity levels	Low activity levels	-0.26	0.15	0.274	-0.644	0.112
		Vigorous activity levels	-0.34*	0.10	0.006	-0.603	-0.078
	Vigorous activity levels	Low activity levels	0.07	0.14	1.000	-0.270	0.420
		Moderate activity levels	0.34*	0.10	0.006	0.078	0.603
Task involving climate	Low activity levels	Moderate activity levels	-0.169	0.15	0.823	-0.541	0.202
		Vigorous activity levels	-0.55*	0.14	0.000	-0.894	-0.215
	Moderate activity levels	Low activity levels	0.16	0.15	0.823	-0.202	0.541
		vigorous activity levels	-0.38*	0.10	0.001	-0.643	-0.127
	Vigorous activity levels	Low activity levels	0.55*	0.14	0.000	0.215	0.894
		Moderate activity levels	0.38*	0.10	0.001	0.127	0.643
Social relatedness supporting climate	Low activity levels	Moderate activity levels	-0.22	0.18	0.711	-0.668	0.227
		Vigorous activity levels	-0.48*	0.16	0.014	-0.892	-0.075
	Moderate activity levels	Low activity levels	0.22	0.18	0.711	-0.227	0.668
		vigorous activity levels	-0.26	0.12	0.126	-0.574	0.047
	Vigorous activity levels	Low activity levels	0.48*	0.16	0.014	0.075	0.892
		Moderate activity levels	0.26	0.12	0.126	-0.047	0.574
Autonomy supporting climate	Low activity levels	Moderate activity levels	0.16	0.17	1.000	-0.251	0.574
		Vigorous activity levels	-0.24	0.15	0.379	-0.617	0.136
	Moderate activity levels	Low activity levels	-0.16	0.17	1.000	-0.574	0.251

	(I) PA levels	(J) PA levels	Mean difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Enjoyment	Vigorous activity levels	vigorous activity levels	-0.40*	0.11	0.002	-0.687	-0.115
		Low activity levels	0.24	0.15	0.379	-0.136	0.617
		Moderate activity levels	0.40*	0.11	0.002	0.115	0.687
	Low activity levels	Moderate activity levels	-0.00	0.20	1.000	-0.497	0.488
		Vigorous activity levels	-0.47*	0.18	0.033	-0.929	-0.029
	Moderate activity levels	Low activity levels	0.00	0.20	1.000	-0.488	0.497
		Vigorous activity levels	-0.47*	0.14	0.003	-0.816	-0.133
Physical activity	Vigorous activity levels	Low activity levels	0.47*	0.18	0.033	0.029	0.929
		Moderate activity levels	0.47*	0.14	0.003	0.133	0.816
	Low activity levels	Moderate activity levels	-0.07	0.18	1.000	-0.529	0.373
		Vigorous activity levels	-0.42*	0.17	0.043	-0.834	-0.010
	Moderate activity levels	Low activity levels	0.07	0.18	1.000	-0.373	0.529
		Vigorous activity levels	-0.34*	0.13	0.026	-0.657	-0.031
	Vigorous activity levels	Low activity levels	0.42*	0.17	0.043	0.010	0.834
		Moderate activity levels	0.34*	0.13	0.026	0.031	0.657

* The mean difference is significant at the 0.05 level.

DISCUSSION AND CONCLUSIONS

The aim of this research was to investigate associations among task and ego-involving climate, autonomy support, and social relatedness; additionally, enjoyment and physical activity, which are not part of the motivational climate questionnaire, with the physical activity levels of female students in Budapest (13-15 years old, M = 14.07; SD = 0.87) and differences in the components of IMCPEQ depending on students' physical activity levels.

The highest mean was associated with a task-involving climate, whereas the lowest was linked to an ego-involving climate. (Soini et al., 2014; Amaro et al., 2023; Jakobsen, 2023; Rodrigues et al., 2024). These findings point out that students perceive a task-involving climate more than an ego-involving climate in physical education classes. Therefore, professionals, managers, and PE teachers should focus on values referring to the development of skills and individual improvement and promote teamwork among their students while underlining the importance of every single student as part of the team. Eventually, attention should be directed to aspects reinforcing a task-involving climate during the physical education lessons to set off students' motivation to participate in physical activities. Whereas an ego-involving climate is attributed to less positive characteristics. This is supported by the research of (Chicau Borrego et al., 2021; Albert, 2022; Isoard-Gautheur et al., 2022; and McLaren et al., 2024). Pearson's correlation coefficient between the variables supported the above, where the highest correlation was that of the task-involving climate with other variables, while the lowest correlation was from the ego-involving climate with other variables. Besides, no significant correlation is found between the ego-involving climate with levels of physical activity and social relatedness; other correlations were also weak and negligible. Also, Pearson's correlation coefficient showed that all the variables of the intrinsic motivational climate of PE lessons, that is, task-involving climate, social relatedness-supporting climate, and autonomy-supporting climate, even enjoyment, and physical activity, which do not form part of the intrinsic motivational climate of the PE lessons, are in significant positive relation with the physical activity of Hungarian female students. Although the correlation at present is weak between the IMCPEQ and the PA levels variables, it was a bit stronger for the task variable. It is expected this will be considerably improved when the study population becomes larger. Theoretically, the IMCPEQ comprises three fundamental components in meeting the three psychological needs proposed in Self-determination Theory (Deci & Ryan, 2000) and Achievement Goal Theory (Nicholls, 1989): autonomy, social relatedness, and competence (task-involving climate). In this study, the internal correlations of the three factors mentioned above were moderate and positive, which indicated that the school's physical education environment was effective in meeting the above-mentioned three psychological needs. The findings of the one-way ANOVA indicated that there was a significant difference between the intrinsic motivational climate of PE lesson variables and the PA of the students. Therefore, to find out which groups these significant differences relate to, the result of the Post hoc test with Bonferroni corrections was used. Significant differences were found in variables such as ego, task, autonomy, enjoyment, and physical activity between moderate and vigorous levels of physical activity. In

addition, there were also significant differences between the low and vigorous levels for the variables of task, social, enjoyment, and physical activity. As the study population increases, differences in all physical activity levels would be more likely to be apparent. In addition, physical activity was increased with increased variables of IMCPEQ which aligns with previous studies. (Zurita-Ortega et al., 2019; Gil-Arias et al., 2020; Kokkonen et al., 2020; Berki & Tarjányi, 2022; Mouratidou et al., 2022). To summarize, IMCPEQ, as analysed by the Self-determination Theory and Achievement Goal Theory, encouraged physical activity. According to the study results and based on the higher mean and correlation of the task-involving climate, students' personal development, objectives, and expertise in skills should be emphasized.

Limitations and Future goals

Our research was correlational; therefore, no causal relationship can be established between these variables. Moreover, our research focused on Hungarian female students aged 13 to 15, and this result can be different in other societies with changes in norms, culture, values, and traditions. In addition, the male group can also differ because their activities are generally higher than those of the female group.

Further studies are encouraged, especially within other communities: male students, students at different educational levels, and non-school sports settings. The study was cross-sectional; hence, longitudinal and experimental studies may help complement the comprehensive view.

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THE ISSUES OF TRAINING AND CHANGING ATTITUDES TOWARDS/FOR PHYSICAL AND SPORTS ACTIVITIES

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ABSTRACT. Attitudes determine how the individual acts towards others and towards different social events, feelings, behaviors and choices becoming predictors of behavior. The sources of attitude formation are social learning, social comparison and genetic inheritance, these functioning as very influential cognitive patterns. Often, attitude establishes behavior, but there are also situations in which there are gaps between them. Knowledge and awareness of the effects of physical and sports activities, in correlation with different demographic and psycho-social variables, constitute the premises for the formation and change of the individual's attitudes. Favorable attitudes towards (practicing) physical and sports activities are positively associated with behavioral intentions in different contexts (within the school curriculum in physical education classes, in an autonomous regime, in free time, in sports clubs and associations specific to certain sports branches, etc.), producing effects on the individual, but also at the level of the community to which he belongs. Sometimes sports contexts, especially those associated with high-performance sports, can also cause negative attitudes with negative influences on the personality, behavior and mental health of the individual (athlete, coach). The attitudinal changes towards (the practice of) physical and sports activities are the result of a dynamic, staged process, sometimes assisted by specialized personnel, the effects of the change occurring at the cognitive and affective level, and, subsequently, at the psychomotor level, of action. The processes of training and attitudinal change towards practicing physical and sports activities, including performance sports, can vary throughout life.

Keywords: *attitudes, physical activity, sport, mental health.*

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REZUMAT. ***Problematicile formării și schimbării atitudinilor față de/ pentru practicarea activităților fizice și sportive.*** Atitudinile determină modul în care individul acționează față de ceilalți și față de diferite evenimente sociale, sentimentele, comportamentele și alegerile devenind predictori ai comportamentului. Sursele formării atitudinilor sunt î*nvățarea socială*, *compararea socială* și *moștenirea genetică, acestea funcționând* ca niște tipare cognitive foarte influente. Adesea, atitudinea întemeiază comportamentul, dar există și situații în care există decalaje între acestea. Cunoașterea și conștientizarea efectelor activităților fizice și sportive, în corelație cu diferite variabile demografice și psiho-sociale, constituie premisele formării și schimbării atitudinilor individului. Atitudinile favorabile față de (practicarea) activităților fizice și sportive sunt asociate pozitiv cu intenţiile comportamentale în contexte diferite (în cadrul curriculei școlare la orele de educație fizică, în regim autonom, în timpul liber, în cluburi și asociații sportive specifice unor ramuri sportive etc.), producând efecte asupra individului, dar și la nivelul comunității din care face parte. Uneori, contextele sportive, în special cele asociate sportului de înaltă performanță, pot determina și atitudini negative cu influențe negative asupra personalității, comportamentului și a sănătății mentale a individului (sportiv, antrenor). Schimbările atitudinale față de (practicarea) activităților fizice și sportive reprezintă rezultatul unui proces dinamic, etapizat, uneori asistat de personal specializat, efectele schimbării producându-se la nivel cognitiv și afectiv, și, ulterior, la nivel de psihomotor, de acțiune. Procesele de formare și schimbare atitudinale față de practicarea activităților și fizice si sportive, inclusiv a sportului de performanță, pot varia pe tot parcursul vieții.

Cuvinte cheie: *atitudini, activitate fizică, sport, sănatate mentală.*

INTRODUCTION

In general, attitude is seen as an individual predisposition to assess a social item (fact, event, person) considering it favorable or unfavorable and, therefore, manifesting a certain behavior towards it. Given their organization through experience, attitudes are acquired during life through single or multiple, direct or indirect experiences. In other words, attitudes are formed through a process of social learning. However, some research has shown that social comparison processes and genetic factors also intervene in the formation of attitudes.

It is known that both affective and behavioral factors, as well as cognitive factors, act in the formation of attitudes. However, the distinction between "explicit attitudes", based on conscious evaluations, and "implicit attitudes", spontaneous, not consciously controlled, must be taken into account.

As a rule, there is a concordance between explicit and implicit attitudes, but dissociations can sometimes appear in the assessments we make. The evaluation depends on how the person's feelings about the "object" of the attitude appear, on the beliefs that people have about those objects, on past experiences with these objects.

Attitudes, even if they are the result of learning, being acquired from direct experiences with objects and contextual situations, are also influenced by other factors: genetics, social comparison.

Attitudes change as a result of lived experiences. The cognitive side is often altered by the acquisition of up-to-the-minute information, the affective side is often altered by unpleasant experiences involving the attitude object, and the behavioral side is often altered by changes in norms or laws that force a behavioral change.

The intentionality of individual or collective behaviors is determined by the influences of an individual's attitudes towards a certain field of activity, in general, and towards the practice of physical and sports activities, in particular, in different social contexts. The development of attitudes is influenced by motivation, interests, but also by learning from socially lived experiences, producing changes in attitudes, but also at the level of the individual's personality. Behavioral change associated with physical activity and actual behaviors are premised on awareness and knowledge of behavioral recommendations, with those who are aware being more physically active than those who are not. In addition, health behavior change related to physical activity may be the result of a dynamic process carried out in stages over the life course.

In this article, we aim to highlight the issue of training and attitude change, which can also be applied to the process of forming attitudes towards and/or for practicing physical and sports activities. In order to achieve this goal, we set the following objectives: 1. defining the concept of attitude; 2. the mechanisms for the formation of attitudes, including those towards physical and sports activities; 3. identifying predictors of behavioral intentionality depending on attitudes towards physical and sports activities; 4. the influences of attitudes on the individual and on the community he/she belongs to; 5. mechanisms for producing attitudinal change towards physical and sports activities.

THE CONCEPT OF ATTITUDE

Most definitions consider *attitude* as an individual predisposition to evaluate a social item (fact, event, person) considering it favorable or unfavorable and, therefore, manifesting a certain behavior towards it (Bogardus, 1933;

Allport, 1935; Popescu-Neveanu, 1978; Barron & Byrne, 2000; Abric, 2002; quoted by Boza, 2010; Smith, 1968; Latchanna & Dagnew, 2009; Tufan & Gudek, 2008; Demirel & Un, 1987, quoted by Korkmaz et al., 2020; Katz, 1960, Ajzen, 1985, Eagly &Chaiken, 1993; Doron & Parot, 1999).

The forms of manifestation suggest that attitudes have multiple properties, depending on the evaluative and affective dimensions (positive/negative, favorable/unfavorable attitudes), polarization and power (stronger/weaker intensity), accessibility (more (re)active/less active), and the individual's identity dimension (more important/less important) (Boza, 2010). Manifested separately (just one) or concurrently (two at a time), attitudes fulfill a role of knowledge, as a result of personal evaluations of objects or events, they represent frames of reference, establish unipolar or bipolar links and associations, determining a behavioral response the. Another role is that of social/utilitarian or instrumental adaptation, favorable/unfavorable attitudes, giving us the opportunity to satisfy some needs (approval/disapproval, expression of positive/negative emotions in a social context). Other roles are related to the possibility of externalizing the beliefs and values that guide us, differentiating ourselves from others (expressive role), but also of protecting or increasing our self-esteem in the face of external threats or internal conflicts (ego defense role) (Katz, 1960, quoted by Boza, 2010).

Boza (2010) summarizes the structure of attitudes, analyzing several conceptualization models from the specialized literature. The simplest model, the unidimensional one (Olson & Zanna, 1993), defines attitude as a global evaluation of the attitude object on a continuous dimension of favorable/ unfavorable type, while the most widely used, the three-dimensional model of the internal structure of attitudes (Rosenberg & Hovland, 1960) claims that in the structure of attitudes there are three types of interdependent components (the "interactive trilogy") (Tapia, 1991): affective (emotions, feelings together with the physiological reactions that accompany them towards a certain object), cognitive (the evaluation of the object is based on knowledge, perceptions, beliefs, opinions, representations, memories about the attitude object and its characteristics), behavioral (intentions and predictions on how a person can act in relation to a fact or event based on his assumptions and convictions). A positive rate of one dimension of the attitude corresponds to a similar one for the other two components, with direct links and of the same intensity between the behavioral and cognitive components, between the cognitive and affective components. Other models of attitudes include: the socio-cognitive model, in which the cognitive side of attitudes and their social function are emphasized (Pratkanis, 1989); the schematic model in which information is encoded, stored, recalled, and used in attitudinal judgments; the attitude representation model (ART model) with the help of which one can answer "how a person's

behavior is influenced, in different situations relevant to the attitude, by different subjective cognitive processes" (Lord & Lepper, 1999, p. 336); the associative model (attitudes are a learned association between an object and an evaluation, an evaluation that is related to a strong affect or a cognitive inference) (Fazio, 1985), the associative-integrative model of attitudes and self-variables (attitudes are activated as a result of the cognitive consistency of the association of a social object with a concept-attribute with a certain valence, the individual's self-concept influencing the behavioral response) (Greenwald & Banaji, 2002).

ATTITUDES TRAINING

Social learning, social comparison, and genetic inheritance are accepted as sources of attitude training. In general, psychosociologists argue that attitudes are learned socially, with affective, behavioral, and cognitive factors intervening in their formation. Baron and Byrne (2006) argue that many associative conditionings occur at a subliminal level, without awareness of the presence of stimuli and/or their association. Numerous "beliefs" are formed through the mechanism of reward and punishment, that is, instrumental conditioning. To the same extent, positive attitudes toward school or work are based on the principle of operant reinforcement through rewards, even if, over time, motivation becomes intrinsic. Bandura (1973) demonstrates that attitudes and behaviors are not learned only from direct experiences, but also by directly observing the behaviors of others and their consequences.

Rotariu and Iluț (1996) propose the concept of cognitive-complex learning according to which human individuals, as they mature, acquire knowledge, attitudes and ways of behaving through more complex ways (logical deduction, reading, other people's stories, daily reflexivity). Mea and Hoe (2005) argue that attitudes are learned experiences and results from social experiences. Festinger (1954) believes that our points of view on social reality are evaluated as correct or not by comparing them with others. Also, through comparison we adopt attitudes identical to the people and groups we value or whose favor we want to enter. According to Iluț (2004) social comparison involves cognitive-complex learning and self-analysis, the training of attitudes being closely linked to the process of their change.

Paniș and Lungu (2020, p. 39) suggest rules for the formation of attitudes. On the one hand, attitude is an object of learning and change, and on the other hand, attitude acquisition is achieved in different ways: direct contact with the object or person, interaction with those who hold an attitude, social experience assimilated in formal and informal groups, cognitive development.

In general, it is considered that attitude establishes behavior. However, numerous experiments have demonstrated the gap that can exist between the behaviors and attitudes of individuals. This gap can be attributed to different causes: a) the influence of the immediate situation that involves numerous stimuli that act directly on behavior; b) the action of several complementary or contradictory attitudes on the behaviour; c) the gap between the moment in which we study the attitudes of a subject or a group and the moment in which the real behavior is observed. During this time frame, attitudes can change depending on certain events (Boza, 2010).

According to the studies, direct hereditary determinism represents another source of attitude formation, being analyzed on the one hand, the ways in which the genetic factor influences the adoption of specific attitudes towards certain social events or social evaluations (job satisfaction, for example), and on the other hand, the correlation between direct hereditary determinism and attitudes with a higher genetic weight that are more difficult to change and that determine actual behavior (Crealia & Tesser, 1996, quoted by Iluţ, 2004, p. 52).

Triandis (1971, quoted by Owusu-Fordjour, 2021) argued that behavior could be predicted by supporting four components: attitude, norms, habits and expectations. When the four components are consistent, there is a strong link between attitude and behavior. However, when the four factors are inconsistent, the link between attitude and behavior is weak.

1. Training attitudes towards and/or for practicing physical activities and sports

Attitudes are relevant, considerably influencing the individual or collective behaviors of the social actor and functioning as highly influential cognitive patterns. They reflect a set of beliefs, feelings and behaviors related to each other, which are organized around an object or situation, which can be favorable or unfavorable (Bebetsos & Antoniou, 2008, Araújo & Dosil, 2015).

There are situations when the attitude towards others determines the attitude towards oneself or can change the mood, etc. Therefore, attitudes help us to select from the surrounding world the objects that have value for us, eliminating the insignificant ones. In this sense, we can say that attitudes, as more or less permanent dispositions of the individual, ensure stability of the personality and provide each of us with a selective perception of the world that surrounds us (Hsu and Huang, 2010). The literature confirms that attitudes are a strong predictor of behavior, which can be dynamic, built, taught, modified or even replaced (Cid et al., 2008; Feldman, 2001; Morales 2000; Zabalza, 2000; quoted by Araújo & File, 2015).

There are studies that can explain positive correlations between the influences of attitudes towards physical activities and sports on behavioral intentions (to practice these activities), in different social contexts (within the school curriculum in physical education classes, autonomously, in free time, in sports clubs and associations specific to certain sports branches, etc.) (Araújo & Dosil, 2015; Zaman et al., 2018; Gu et al., 2022; Zeng et al., 2011; Kopczynski et al., 2014; Dawood, 2020; Tabussum et al., 2017).

Although the many beneficial effects of physical and sports activities are widely known, both physically and psychosocially, sedentary behavior is continuously increasing throughout the population, making physical inactivity a public health problem. Policies are being proposed and implemented to change attitudes towards physical activity, by promoting positive attitudes towards exercise, as well as through prevention and intervention strategies for health-related behaviors.

There are also studies that certify the influence of different demographic variables (gender, age, residential environment, income, health status, etc.) and psychosocial variables (education level, lifestyle, cultural factors, group, etc.) in predicting behavioral intentionality towards physical activity (Ali et al., 2015, Pulur et al., 2011, Tomik et al., 2012, Dacey et al., 2014, Drum et al., 2016, cited by Zaman et al., 2018; Cid, 2010, Dosil, 2005, quoted by Araújo and Dosil, 2015, Chun and Phillips, 2002, Portman, 2003, quoted by Zeng et al., 2011, Elena and Beata, 2017, quoted by Dawood, 2020):

- ✓ Training positive attitudes towards physical activities at a young age will predict their behaviors in adulthood as well, throughout life.
- ✓ Middle school children express very favorable attitudes towards the health, fitness, enjoyment and socialization (social interactions) effects of physical activities, but do not enjoy physical activities that involve intense exercise and movements that involve risk-taking.
- ✓ Not only favorable attitudes are cultivated for practicing in the academic environment (during physical education classes or during extracurricular activities), but also outside it, as free time activities. Children who have more positive attitudes towards physical activity are more likely to participate in physical activities outside of school.
- ✓ Interest in physical activities is positively associated with the content of physical activities in the lessons included in the curriculum (which activities are practiced), with the teacher and his/her pedagogical skills, with the ways of implementing the activities (preferences for teaching content in a playful, competitive manner, team activities and sports to the detriment of individual ones, etc.), with sports facilities and equipment, etc.

- ✓ Positive attitudes towards physical activities are due to the fact that they have positive influences on the development of cognitive capacities in students and, once they are aware of them, they are given (greater) importance. Several studies highlight the existence of a relationship between motor capacity and cognitive development in children, with motor and cognitive functions being coupled at the cerebellum level, with neural connections at the pre-frontal cortex level being important in expression, and with the fact that both develop at the same time at an accelerated pace (5-10 years), with common underlying processes (Diamond, 2000; Ahnert et al., 2003; Anderson, 2002; Gabbard, 2008; Hartman et al., 2010, cited by Westendorp et al., 2011). Thus, dysfunctions at the level of the brain generate motor and cognitive difficulties, intervention programs in primary school can bring benefits. In addition, engaging in physical activities is shown to increase students' academic performance, can increase engagement with the subjects they study.
- ✓ Attitude levels towards physical activities of students fluctuate in relation to residential areas, for example, those living in cities have a higher level of attitude, and students living in metropolitan areas are involved in physical activities for aesthetic reasons (to build a beautiful and fit body).
- ✓ Attitudes towards physical and sports activities of boys are more positive compared to those of girls, being more active and physically fit. Students' attitudes towards the aesthetic influence of physical activities are positive for both sexes, but girls show a more favorable attitude compared to boys. However, boys show a stronger interest in the fitness and health aspects of physical activities.
- ✓ Attitudes towards physical activities are also positively associated with the social development and achievement (/achievement of goals) of individuals, but also with positive effects at the level of social and cultural education in schools. Children enrolled in school sports clubs have greater pro-social behavior towards sports compared to their friends who are not involved in practicing a sport. Also, a player's behavior is greatly influenced by teammates and coaches.

It has been shown that people who enjoy the benefits of physical activity have a positive and favorable attitude towards physical activity, and the acceptance of these activities at the community level leads to a high level of practice and support for them (Raslan, 2015, quoted by Zaman et al., 2018). It is beneficial to acquire positive attitudes towards movement, with cultural, economic and social effects at the institutional, community and societal levels (Tomik et al., 2012, quoted by Zaman et al., 2018). Therefore, education is a way

of civilizing and developing a healthy society (AL-Liheibi, AHN., 2008, quoted by Tabussum et al., 2017), and the means and forms of manifestation of physical and sports activities can be the vector for transmitting these values and principles to be learned and applied in different situations and social contexts.

While the influence of positive attitudes is a much more researched topic, the role of negative attitudes towards physical activities is less studied. The beliefs of some individuals, for example, obese people, especially children, such as that physical exercise is painful, that it also has negative consequences (it takes a lot of time), that practicing involves receiving criticism, teasing, stigmatization, prejudices and stereotypes, etc. represent negative attitudes developed and with possible behavioral influences of physical inactivity, even intentional (Nelson et al., 2010; Kopczynski et al., 2014). Negative attitudes can be reinforced by previous direct experiences, but at the same time, they can be changed in a positive way, requiring a lot of determination and resources allocated by the individual directly involved, as well as by those around them.

It is accepted by the scientific community that interest, motivation and attitude in performance sport are associated psychological factors of success. The attitude represents a stable acquisition of the athlete's personality, which reflects how he is positioned in relation to the stimuli from training/ competition and those from the specific environment. It has a bipolar manifestation (positive and negative) that conditions a certain behavior and its efficiency in achieving sports excellence.

As a mental process, the attitude is based on perception, thinking, affective state, determining the judgment of the situational reality and conditioning the athlete's decision to react in a certain way. The attitude depends on the interests, motivation, convictions and the aspiration towards the great performance. It manifests itself in sets of anticipation, determining the orientation and selection of the athlete's operational acts.

The attitude is expressed both through ideas, opinions, opinions, convictions, as well as through adherence to a certain behavior and a certain way of reacting to events in training and competitions. The attitude is based on the psychological factors associated with sports success, it is formed gradually and regulates the conduct of the elite athlete.

Epuran (1990) proposes a model - 4A (skills, attitudes, training, environment) which includes a complex of factors that contribute to achieving sports performance. In the author's opinion, the system of attitudes is relevant to the athlete's personality, being dynamic and complex under the influence of education and accumulated experiences, contributing to achieving success in sports activity. Thus, attitude can be considered as a premise and mediator in achieving sports performance. The athlete makes a selection of responses to

situations, phenomena, people and objects in sports contexts, giving the human personality characteristics of uniqueness and originality in action. Epuran (1990, p. 52-53) also proposes a list of attitudes specific to sports (in training and competition, towards the coach, referees, etc.), attitudes that can be considered "conditional skills of performance, but also educational objectives with the role of maximizing the athlete's mental ability".

Each type of attitude creates a certain type of relationship in interpersonal communication. Three categories of attitudes are identified. The first category concerns *attitudes towards oneself* that reflect the characteristics of self-image, developed on the basis of self-perception and self-evaluation, but also of the perception and evaluation of those around them. They are based on self-awareness, self-image, in other words, on the representation that each person has about themselves. Attitudes towards oneself are expressed through dignity, pride, arrogance, self-confidence, self-confidence, modesty or lack of modesty, thus marking the behavioral "style" of the individual, as well as his or her relationships with peers.

Sports situations stimulate self-knowledge, as well as self-analysis and self-evaluation skills. Self-evaluation appears in the athlete along with the desire to know oneself and to prove the limits of one's own potential during confrontation with opponents and various other obstacles.

Sport offers multiple ways, especially for children and adolescents, to overcome their inferiority complexes, frustrations and to compete with themselves and others, to compare themselves with their idols. Thus, the athlete demonstrates, compared to the individual who does not practice any sport, a greater ability to self-evaluate their possibilities, motivations, needs and desires, a capacity that represents for them a facilitating factor of success.

The second category concerns *attitudes towards society* that differentiate and individualize, according to the situations created (towards work, towards moral norms, principles and standards, towards institutions – family, school, state, church, etc., towards political organization, towards a profession, etc.). This type of attitude is expressed through feelings of patriotism, which act as an orientation, dynamization of the athletes' activity, determining them to defend the colors of the national flag with honor, achieving exceptional performances. The attitude towards work will be expressed through feelings of fairness, responsibility, discipline and order, in the activity carried out, and which will lead to obtaining the expected results and performances. In sports, the attitude towards work, coach, team (for team sports) is essential, decisive and conditions success.

The third category of *attitudes* are those *towards peers* that reflect the need to develop socio-affective relationships, the need for group membership and communication, adhesion and identification with the group, to be appreciated

by others, etc. Practicing physical and sports activities offers everyone the opportunity to develop communication relationships, cooperation with others, to be part of the group(s), participating in achieving the group's objective, sharing common experiences of developing oneself with the help of the group, building one's own identity, but also a social identity in relation to other groups, etc.

However, there are also a series of negative attitudes associated with practicing elite sports (in training, but especially in competition) with negative influences on the personality, behavior and mental health of the athlete/coach. Sometimes athletes adopt negative attitudes towards exaggerated reactions to stressful situations, mood swings, deviant behaviors associated with injuries, burnout, overtraining syndrome associated with physiological dysfunctions, avoidance/refusal of help and support from family and specialists, the fear of the consequences of this search, the lack of time, the stigmatizing attitude, the low level of education of the athlete in relation to his mental health are barriers that can contribute to a delay in recognizing symptoms and adopting intervention measures to solve emerging mental health problems or to prevent them (Watson et al., 2021).

Pierce et al. (2021, quoted by Rusu, 2022) propose an approach to increase awareness of the importance of athlete well-being and to adopt interventions, focused on three directions: a) education (literacy of athletes, coaches, those involved in performance sports to improve understanding, reduce stigma and promote early intervention); b) development of athletes, in the development of sports careers, as well as personal and professional development outside of sports activity); c) mental health screening and feedback to athletes (multidisciplinary specialized teams or qualified mental health professionals to manage mental disorders in athletes).

Studying the features of practicing extreme/adventure sports outdoors is another theme in which several studies are found that aim, on the one hand, at the nature and characteristics of attitudes towards these forms of sporting activities, and on the other hand at changing attitudes towards this sport, highlighting the awareness of the beneficial effects on the individual (increased physical performance, personality traits and mental health – managing emotions and stress, self-knowledge and self-realization, etc.), but also on the community and the natural environment in which these activities are practiced (pro-nature attitudes and reconnection with it, ecological attitudes and sustainability of the practice areas, etc.) (Brymer et al., 2015, quoted by Rusu and Rusu, 2021, Bėlanger et al., 2019, Clough et al., 2016).

CHANGING ATITTUDES/BEHAVIOR TOWARDS PHYSICAL AND SPORTS ACTIVITIES

The link between behavioral attitude and behavioral intention is scientifically proven. Attitudes determine how the individual acts toward others and toward various social events, and therefore feelings, behaviors, and choices become a powerful predictor of behavior. The development of attitudes is influenced by motivation, interests, but also by learning from socially lived experiences, producing changes in attitudes, but also at the level of the individual's personality.

Iluț (2004) suggests that education and persuasion are two vectors that can induce and produce the change of some attitudes, just as some attitudes are acquired and spontaneously transformed through direct experiences. These changes in attitudes are consequences of information received and processed from different sources, which presuppose adaptations on the part of the individual. Therefore, in order for a change to occur, the source (who issues the information - an individual, a group or an institution that transmits a credible message), the content of the message, the means of communication, the target pursued (on the one hand, the goals pursued, but also the psycho-social context - the level of education, the training environment, expectations, mentalities, the system of interpersonal relationships of the receivers, etc.), and resistance to change are important. If the source deliberately pursues the attitudinal change through more or less deceptive means we refer to persuasion, but if this change occurs in the interest of the source (the manipulator) we refer to manipulation. We can also talk about positive manipulation, not just negative, when the change takes place in the interest of the manipulated. In the case of manipulation, the target is neither the intentions of the source nor the fact that it is being influenced.

Several theoretical models have been developed to explain and study how attitudes guide behaviors, and they lead to changes in attitudes:

- *the stimulus-response theory* - between the stimulus and the response there are processes of attention, understanding, acceptance, the response requiring an attitudinal change. Attitudes change to the extent that the source, factors, and social context of the new response-requiring stimulus are more attractive than the old response stimulus (Chelcea, 2000).
- *the theory of reasoned action (TRA*), formulated by Fishbein and Ajzen (1975), claims that individuals rationally calculate the costs and benefits of the actions they could perform, also taking into account how others will judge the respective actions. Thus, in the decision-making process, the individual deliberates consciously.

- the theory of planned behavior (TPB) (Ajzen, 1991) is an extension of the theory of rational action to which the concept of perceived control of behaviors is added. This theory supports the intention-based predictability of behavior and acting in accordance with this associated intention. Behavioral decisions are made following a process motivated by one's beliefs and values, where behavior is influenced by behavioral attitudes, subjective norms, and perceived behavioral control.

This theory predicts the intentionality of behaviors in several areas of activity: consumer choices, environmental protection, health promotion, tourism development, driving behavior, etc. (Hsu & Huang, 2010). There are studies that can explain positive correlations between the influences of attitudes towards physical activities and sports on behavioral intentions (to practice these activities), in different social contexts (within the school curriculum in physical education classes, in an autonomous regime, in free time, in sports clubs and associations specific to certain sports branches, etc.) (Araújo & Dosil, 2015; Zaman et al., 2018; Gu et al., 2022; Zeng et al., 2011; Kopczynski et al., 2014; Dawood, 2020; Tabussum et al., 2017).

- *the health belief model (HBM*) is a psychological model of health behavior change, also related to physical activity. Proposed in the 1950s, with adaptations in the 1980s by the US Public Health Service, the model includes several constructs: perceived susceptibility (a person's subjective perception of the disease or risk of acquiring a disease), perceived severity (a person's feelings about the seriousness of contracting or not treating a disease, taking into account both medical and social consequences), perceived benefits (a person's perception of the effectiveness of different actions available to reduce the threat of the disease or to cure the disease), self-efficacy (a person's level of confidence in their ability to successfully perform a behavior), and cues to action (stimuli needed to trigger the decision-making process for to accept an action recommended for health, stimuli that can be internal and/or external to the individual). The model has been used to prevent or detect disease, with several psychosocial and demographic variables (gender, age, race, area of residence, education level, income, etc.) influencing perceived barriers and motivators (Rosenstock, 1974).

According to the application of this model in explaining behaviors related to physical activity, studies show that the most frequent perceived barriers to physical activity are lack of time (Spinney & Millward, 2010, cited by Marashi et al., 2021) and lack of motivation (Justin et al. al., 2013, cited by Marashi et al., 2021). Other studies focus on the influences that motivational factors have on the intentionality of physical activity behaviors: benefits for

brain health (Martinsen, 2008, Moutao et al., 2014; Rebar et al., 2015; McMahon et al., 2017; Kleppang et al., 2018; Schuch et al., 2018; Siefken et al., 2019; Murphy et al., 2020; Bastemeyer and Kleinert, 2021; Luiz José Frota Solon Júnior et al., 2021; Wolf et al., 2021), stress management (McEwen & Sapolsky, 2006; Rimmele et al., 2009; Redondo-Flórez et al., 2020; Bastemeyer & Kleinert, 2021; Luiz José Frota Solon Júnior et al., 2021) and sleep quality (Kredlow et al., 201; Antunes & Frontini, 2020; Gilchrist et al., 2021; Khan et al., 2021). The context of the COVID-19 pandemic has made it possible to emerge unique obstacles and motivations for physical activity: even if the lack of time was perceived less, the motivation of individuals to be physically active increased greatly, feeling the state of anxiety and the absence of social support. The motivation for well-being and mental health increased, rather than for health, in general and for physical appearance. Other motivators that emerged during the pandemic period were the improvement of stress and sleep, the reduction of anxiety and the quality of sleep (Marashi et al., 2021).

1. Stages of change in physical activity-related behavior

Behavioral change associated with physical activity and actual behaviors are premised on awareness and knowledge of behavioral recommendations, with those who are aware being more physically active than those who are not (Cameron et al., 2007; Plotnikoff et al., 2007, quoted by Abula et al., 2018; van Sluijs et al., 2007). There are also studies that do not support direct associations between knowledge of recommendations and increased awareness and actual levels of physical activity (Loughlan & Mutrie, 1997; Morrow et al., 2004; Plotnikoff et al., 2007; quoted by Abula et al., 2018), this aspect being attributed to the lack of development of intentions to be physically active.

Health behavior change related to physical activity may be the result of a dynamic process, carried out in stages (Marcus et. al., 1992), with the effects of change occurring at the cognitive and affective levels, and subsequently at the psychomotor, action level. The authors identified *a five-stage model:* 1. precontemplation stage – characterized by physically inactive behavior and no intention to become physically active; 2. contemplation stage – the individual is physically inactive, but the intention to become active is present, yet without concrete action to change; 3. preparation stage – the individual becomes physically active, but not at the recommended level; 4. action stage – the individual is physically active at the recommended level, but this level of activity has been present for less than 6 months; 5. maintenance stage – the individual is physically active at the recommended level and for a period of 6 months or more.

Research (Marcus & Forsyth, 2003; Spencer et al., 2006; Abula et al., 2018) supports the validity of physical activity behavior stages, identifying cognitive and behavioral strategies used during the stages of change. A peak of cognitive strategies (e.g., knowledge acquisition, risk awareness, or understanding benefits) is reached in the preparation stage, while behavioral strategies (such as obtaining social support, self-rewarding, or self-reminding) usually reach their highest level in the action phase. Therefore, for successful behavior change, i.e., an increase in awareness of physical activity recommendations, it can only be applied in the precontemplation, contemplation, and preparation stages. Knowledge of physical activity recommendations could lead to an increase in intentions to participate in physical activity regularly. In terms of actual behavior, it is possible that an automatic increase in awareness of recommendations may not automatically produce an increase in physical activity levels, as behavioral strategies have greater relevance in the action and maintenance stages (Abula et al., 2018).

Because physical inactivity has become an important public health issue, the World Health Organization has established a series of recommendations to promote regular physical exercise among the general population, without considering daily physical activities, but taking into account biological and psychosocial maturation, as well as existing pathologies. Intensity, duration, and frequency are the components of interest in physical activities. Thus, light physical activities include activities that do not cause a noticeable increase in the functioning of the cardio-respiratory system (for example, light walking). Those with moderate intensity produce a noticeable increase, but do not stop, for example, a conversation (the heart beats faster than normal, and breathing is faster than normal). Vigorous physical activities cause a stronger than normal increase in heart and respiratory rates to a point were, for example, a conversation can no longer be maintained. The general recommendations (WHO 2018, www.who.int) include: a) for children and young people (2-18 years) – moderate to vigorous physical activity of at least 60 minutes per day; b) for adults (18-64 years) – physical activity of at least 30 minutes per day, of moderate intensity (5 days per week or 150 minutes per week at moderate intensity or at least 75 minutes per week at vigorous intensity); c) older people (over 65 years) – at least 30 minutes per day of moderate activity, 5 days per week or 150 minutes per week, with a focus on aerobic activity, improving muscle strength and balance.

Also, as a policy to promote physical activity, WHO (2010) recommends that primary health care be consistent. In a study developed by Carroll et al. (2012), the effectiveness of a *5A intervention model*, successfully used in combating smoking, is presented, which clinicians should be trained to use in behavioral counseling in primary care regarding the physical activity of the population.

The 5A intervention model involves a step-by-step approach to effective counseling of clinicians in their relationship with patients in order to change their behavior towards physical activity: a) ask or assess current behavior, the desire to change and to enroll in a community program that supports physical activity (ask/assess); b) advise on a possible change, taking into account in recommendations existing health issues (if there are pathologies associated with the current condition) and the life context that can maximize motivation for change (advise); c) accept and agree on a work plan that promotes the benefits of participating in physical activities (agree); d) provide assistance by providing additional resources, referral options or practical problem-solving strategies, helping the patient to ensure the necessary support for changing physical activity (assist); e) organize the treatment/intervention plan, providing the opportunity to follow up and reevaluate behavior change efforts, with the possibility of adjusting the change plan (arrange). In addition to this model that seems to be effective, the approach of patient-centered communication of the medical staff in the relationship with the patient, can lead to a behavioral change towards engaging in physical activity. Clinicians can receive useful information related to facilitators and barriers in the development and implementation of an intervention plan, if they consider and support the patient's perspective of approach (values, desires, expectations, beliefs towards the targeted behavior), his socio-cultural context towards the employability in physical activity (when, if, how, where to get involved). The application of this model has demonstrated an increase in the level and quality of the communication relationship between clinicians and patients, but also the fact that it can be considered a tool for promoting physical activities and changing behavior towards them, of disadvantaged patients, in particular, knowing the inequalities in access to medical care and assistance services (Carroll et al., 2012, 2013, 2014; Wattanapisit et al., 2018; Jones et al., 2021).

CONCLUSIONS

The attitude of a social actor represents an individual predisposition to evaluate a social item (fact, event, person) considering it favorable or unfavorable and, therefore, manifesting a certain behavior towards it. Depending on the lived experiences, training and changing attitudes towards /for practicing physical and sports activities are staged processes, starting from knowledge and awareness of the beneficial effects of physical activities and, therefore, by adopting favorable attitudes towards their practice, in according to socio-demographic and psychological variables. Also, attitudes towards sports take into account specific situational contexts, the training of attitudes towards this type of activity having specific particularities.

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PRE-COMPETITION TAPERING IN HIGH PERFORMANCE SPORTS – A THEORETICAL APPROACH

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ABSTRACT. Aim: The aim of this study is to synthesize the literature on the 'tapering' process, i.e. reduction in training load, which takes place two to four weeks prior to a major competition. **Methods:** The main method used in this material is the literature review method; a total of six studies on this topic have been reviewed. **Results:** A synthesis of the 'tapering' process that should be implemented by every coach before a major competition in the annual competition calendar. **Conclusions:** In order to increase the chances of achieving high performance in major competitions, it is preferable that the training intensity during the taper be high or similar to that of the pre-taper training.

Keywords: *tapering, training sessions, competition, high performance sport*

REZUMAT. ***Descărcarea încărcăturii de antrenament înainte de competiţie în sportul de performanţă – o abordare teoretică*****. Obiective:** Obiectivul acestui studiu este de a sintetiza literatura de specialitate cu privire la procesul de „descărcare" a încărcăturii de antrenament, proces ce are loc cu două până la patru săptămâni, înainte de o competiţie majoră. **Metode:** Ca metodă principală în acest material s-a folosit metoda studiului bibliografic, parcurgând un număr de şase studii care tratează subiectul menţionat. **Rezultate:** Realizarea unei sinteze cu privire la procesul de „descărcare" a încărcăturii de antrenament, proces ce trebuie realizat, de către fiecare antrenor, înainte de o competiţie importantă din calendarul competiţional anual. **Concluzii:** Este de preferat ca, pentru creşterea şanselor de a obţine performanţe la competiţiile majore, în

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perioada de descărcare, intensitatea să fie ridicată sau similară cu cea din antrenamentele din perioada pre descărcare, în timp ce volumul şi frecvenţa antrenamentelor vor fi reduse.

Cuvinte cheie: *descărcare, antrenament, competiție, sport de performanță*

INTRODUCTION

Nowadays athletes cannot be expected to have high performance in major competitions without rigorous training planning that takes into account the annual competition calendar. The literature often refers to 'taper' as the final part of a training plan to be introduced in the final weeks prior to a competition, for a taper has the potential to bring a coach's training plan to fruition or minimize it (Pritchard, Keogh, Barnes, & McGuigan, 2015).

OBJECTIVES

The aim of this study is to synthesize the literature on the 'tapering' process, i.e. reduction in training load, which takes place two to four weeks prior to a major competition.

METHODS

The main method used in this material is the literature review method; a total of six studies on this topic have been reviewed. The main indicators followed in these studies were some of the effort parameters, as volume, intensity and training frequency. In the reviewed studies, the authors mention the fact that decreasing volume and frequency or maintaining training intensity (but reducing frequency of intensive training sessions), for a period between 8-14 days, before a competition, influence the sport performance.

RESULTS

Taper means 'a reduction of the training load during a variable period of time, in an attempt to reduce the physiological and psychological stress of daily training and optimize sports performance' (Mujika & Padilla, 2003, p. 1183).

Reducing the training load along with the catabolic processes during a taper can induce sports performance (Izquierdo et al., 2007, apud Turner, 2011). Such reduction may involve a decrease in training volume, intensity, and frequency, using a specific taper pattern and varying its duration (Bosquet et al., 2007). Notable improvements in sports performance following tapering were seen in rowers, runners, triathletes, cyclists, swimmers, weightlifters (Turner, 2011; Bosquet et al., 2007).

The main purpose of a taper is to reduce the accumulated fatigue and not to improve fitness levels (Mujika & Padilla, 2003).

The fitness-fatigue model is used to highlight how the tapering process may work. This model is based on training after-effects, i.e. after training, the fitness level (adaptation to greater efforts) improves and fatigue occurs, along with physiological changes. According to the literature, performance is the sum of the positive training after-effects (neuromuscular/physiological efficiency) with the sum of the negative after-effects removed (reduced fatigue) (Pritchard et al., 2015).

Taper Types

According to the literature, there are four types of tapers whereby training load can be reduced: linear taper, exponential taper (fast or slow decay of training load), step or nonprogressive taper (Mujika & Padilla, 2003; Le Meur, Hausswirth, Mujika, 2012; Turner, 2011).

A linear taper involves a higher training load compared to an exponential taper. An exponential taper can have either a fast or a slow decay (the training load being higher in the latter case); step taper is a nonprogressive drop in training load (Mujika & Padilla, 2003).

A linear taper can start with a 5% decrease of the pre-taper training load, and then the training load can be decreased each day by another 5% throughout the duration of the taper.

A step taper involves an immediate 50% reduction in training volume from the very first day and then this reduced volume is maintained throughout duration of the taper (Turner, 2011).

The study conducted by Banister and Carter (1999), which compared the applied taper types, and the changes induced in performance, found that an exponential taper was more effective than a step taper; when a fast exponential taper was compared to a slow exponential taper, the former was found to generate improvements in performance (Mujika & Padilla, 2003).

Intensity Reduction

The literature in the field emphasizes the importance of maintaining training intensity during a taper so as to retain the adaptations acquired during pre-taper training. A 1/3 or 2/3 reduction in intensity causes a decrease in aerobic endurance (Hickson et al., 1985, apud Mujika & Padilla, 2003).

Other studies state that competitive performance improved when the training intensity during a taper is high or at least similar to the intensity of the training prior to the taper. In contrast, the results were not as good when low-intensity moderate-volume training was used during taper (Shepley et al., 1992, apud Mujika & Padilla, 2003; Le Meur, Meur, Hausswirth, Mujika, 2012).

Volume Reduction

Training volume can be reduced during a taper, without affecting the adaptations acquired in pre-taper training. The endurance capacity built during 10 weeks of training can be maintained (with no significant changes) in the 15 subsequent weeks during which the training volume is reduced by 2/3 (Hickson et al., 1982, apud Le Meur et al. 2012).

In middle-distance runners, the results were better when the taper included reduced training volumes instead of moderate ones, of course compared to the training volumes in the period prior to the taper (Shepley et al., 1992, Mujika et al., 2000, apud Le Meur et al, 2012).

Studies claim that, in order to improve results, the training volume during a taper should be reduced by 41-60% compared to the pre-taper training volume, by shortening the training duration rather than by reducing the number of training sessions (Le Meur et al., 2012).

A progressive (50-70%; 50-90%) reduction in training volume is recommended in order to maintain the adaptability acquired during pre-taper training and to enhance performance.

Studies show that better results were achieved by progressively (50-90%) reducing the training volume in sports such as swimming, running, cycling, triathlon (Banister et al., 1986, Dressendorfer et al 2002; Johns et al., 1992; Kenitzer, 1998; Millard et al., 1985; Mujika et al., 2000, 2002 apud Mujika & Padilla, 2003).

Training Frequency Reduction

According to some studies, reducing the frequency of training has had no influence on sport performance improvement because such reduction also

affects training intensity, which we already know is important to maintain during the taper (Bosquet et al., 2007, apud Le Meur et al., 2012).

In a study consisting of a 20-km cycling trial simulation, a 50% reduction in training frequency during a 10-day taper resulted in improved performance (Dressendorfer et al., 2002, apud Majika & Padilla, 2003).

Whereas a training frequency reduction is recommended in some sports, maintaining a higher than 80% training frequency during the taper is recommended in swimming (Majika & Padilla, 2003). This behavior is also recommended in high performance gymnastics, which requires a high technical level.

Duration of Taper

According to the literature, a taper duration of 8 to 14 days represents the threshold beyond which it is possible to have a positive influence on performance by reducing fatigue, while the other side of the threshold could bring about detraining and implicitly a decrease in performance (Bosquet et al., 2007). An optimal taper lasts 8 to 14 days; during this time, the training volume is exponentially reduced by 40-60%, while maintaining the training intensity and frequency (Bosquet et al., 2007, apud Turner, 2011).

The table below summarizes how taper influences sport performance through the changes that occur in effort variables. Only the aspects that positively influence performance are listed.

Table 1 includes only the cases where performance values changed positively, according to the literature. In swimming, for example, when the training volume was reduced by 21-40%, the performance decreased (mean values of 0.18, while at a volume of 41-60% compared to pre-taper training volume, the values were 0.81).

Table 1. Performance values induced by changes in effort variables during taper

SPORT	V Reduction				I Reduction		Frecv. Reduction		T Duration				Taper Type	
	≤20 %	21 -40%	41-60%	≥60 %	Yes	No	Yes	No	≤7d	8-14d	15-21d	≥22 d	step	progressive
Swimming	-	-	0.81	-	-	0.28	0.35	0.30	-	0.45	-	-	-	0.27
Track and field	-	0.47	-	-	-	0.37	0.16	0.53	-	0.58	-	-	-	0.46
Cycling	-	0.84	-	-	-	0.68	0.95	0.55	-	1.59	-	-	-	0.28

Source: adapted from: (Bosquet et al., 2007)

CONCLUSIONS

As shown in Table 1, performance in swimming improved when the training volume was reduced by 41-60% of the volume used before the onset of the taper. Performance in running and cycling improved when the training volume was reduced by 21-40% of the pre-taper volume.

In terms of training intensity during taper, performance improvements occurred in all three sports (swimming, running, and cycling) when the training intensity was not reduced during the taper.

As far as frequency reduction is concerned, there were no major differences in swimming. In running, performance was higher when the training frequency was not reduced. In cycling, on the other hand, performance was higher when the training frequency was reduced.

In all three sports, performance improved when the taper lasted for 8 to 14 days, compared to 15 to 21 days or more than 22 days.

In terms of taper types, a progressive taper was more effective than a step taper.

During periods of taper, it is recommended that training intensity be maintained at a high level, while the training volume should progressively decrease by 50-90% of the pre-taper training volume.

Studies show that results were better after tapering through progressive reduction of training volume (50-90%) in sports such as swimming, running, cycling, triathlon.

Comparisons between types of taper show that an exponential taper was more effective than a step taper; of the two exponential tapers, i.e. fast exponential taper and slow exponential taper, the fast one enhanced performance (Mujika & Padilla, 2003).

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MACHINE LEARNING - BASED PREDICTION OF ALGERIAN UNIVERSITY STUDENT PARTICIPATION IN SPORTS ACTIVITIES

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ABSTRACT. Student participation in university sports is influenced by individual, social, cultural, and institutional factors. Despite the recognized benefits of sports, many students face barriers such as academic pressures and inadequate infrastructure. This study proposed a machine learning-based approach to predict sports participation among Algerian university students, focusing on identifying key factors like gender and athletic background to guide inclusive sports policies. Using models like logistic regression and decision trees, the study effectively predicted participation patterns and highlighted the most attractive sports disciplines, enabling better resource planning and tailored programs. This approach offers valuable insights for fostering a dynamic, inclusive sports ecosystem and emphasizes the potential of machine learning to enhance university sports management.

Keywords: *Sport; University; Prediction; Activity; Algeria*

INTRODUCTION

Universities play a central role in the socialization of students by creating an environment where exchanges and social interactions are encouraged, particularly through sports activities. By offering opportunities to practice

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various sports, higher education institutions aim not only to improve students' physical health but also to foster essential skills for their social development, such as teamwork, discipline, and respect for others (Bailey et al., 2013, Stodolska, al. ,2015). These activities, which are an integral part of the university experience, contribute to the development of social awareness by enabling students to become familiar with cooperation and community involvement.

Universities sports will ensure the alignment of athletic achievements with the goal of enhancing the physical potential of younger generations through physical exercise, which is the primary and most effective means for this transformation. University sports hold a crucial place in the academic and social journey of students, playing a vital role in their physical, mental, and social development (Eime, 2013). Within universities, sports are not merely leisure activities; they are a powerful tool for fostering social cohesion, personal discipline, and student well-being. In Algeria, where universities welcome a growing influx of students each year, sports participation remains limited to a small number of participants and disciplines. This situation highlights a significant challenge: despite access to sports facilities and the well-known benefits of physical activity, a low proportion of students engage in the sports activities offered.

This issue leads us to explore the reasons behind this limited participation and the factors that influence students' decisions to become involved, or not, in university sports. It is therefore relevant to conduct an in-depth study to analyze students' sports habits, understand perceived motivations and obstacles, and ultimately predict students' participation profiles. By identifying these factors, this research aims to contribute to the development of tailored strategies that encourage broader and more inclusive sports participation within Algerian universities, thereby enabling students to fully benefit from the advantages of physical activity and university life.

Faced with the issue of low student participation in university sports activities, it becomes essential to understand the various factors that influence their choices. Traditional approaches to data collection and analysis are not always sufficient to grasp the complexity of these behaviors, which are often marked by multiple and interconnected elements. This is why machine learning techniques, an advanced branch of artificial intelligence, are particularly well-suited for this study. These techniques allow for the analysis of large amounts of data to extract hidden patterns, revealing trends and correlations that are not immediately visible.

The use of supervised or unsupervised learning in this context will enable us to predict student participation based on variables such as gender, age, sporting background, preferences for certain disciplines, and even perceptions

of the benefits associated with practicing sports. This approach, based on the analysis of complex data, will open new perspectives for identifying the factors influencing student engagement in university sports. As a result, it will provide valuable insights to design targeted and effective strategies aimed at encouraging greater and more inclusive participation in sports activities within universities.

METHODOLOGY

Data Description (Algerian University Sports Dataset)

This dataset contains the comprehensive information on university sports programs across various institutions in Algeria. It includes data on student enrollment, sports participation, categorized by gender and sport. The dataset can be used to analyze trends, and gender disparities in universities sports.

This dataset contains comprehensive information about university-level sports programs across institutions in Algeria, capturing student enrollment, sports participation, by gender. Each row represents a unique record for a specific institution in a particular year, detailing the demographic of sports programs. This dataset can be used to analyze trends in university sports, evaluate gender disparities in participation within Algerian universities' sports programs. The attributes are organized into several categories (See Table 1):

1. **Institution Information**:
   - **Institution identifiers** (such as unit id and institution_name) provide unique identification for each university.
   - **Location details** (city_txt, state_cd, and zip_text) indicate the geographical context of the institution.
2. **Classification Data**:
   - **Institution classification** (classification_code, classification_name, classification_other) categorizes the university by size, focus, or sports participation level.
   - **Sector information** (sector_cd, sector_name) indicates whether the institution is public or private.
3. **Enrollment Data**:
   - **Gender-based enrollment counts** (ef_male_count, ef_female_count, and ef_total_count) provide the total male, female, and combined enrollment figures for each institution.

4. **Sports Participation**:

- *Sports program codes and descriptions* (sports code and sports) specify the types of sports offered.
- **Gender-specific and co-ed participation counts** (partic_men, partic_women, partic_coed_men, partic_coed_women) capture the number of male and female participants in each sport, including mixed-gender teams.
- **Total participation counts** (sum_partic_men, sum_partic_women) summarize the male and female participants across all sports programs.

Table 1. Algerian University Sports Dataset

Attributes	***Description***
Year:	The academic or calendar year during which the data was collected.
Unitid:	A unique identifier for each institution, helping to distinguish between different universities.
Institution_name:	The name of the educational institution or university.
City_txt:	The city where the institution is located.
State_cd:	The code representing the region or state within Algeria.
Zip_text:	The postal or zip code of the institution's location.
Classification_code:	A numeric or alphanumeric code representing the type or classification of the institution (e.g., by size, research focus, or sports level).
Classification_name:	The name associated with the classification code, providing a more descriptive label for the institution type.
Ef_male_count:	The number of enrolled male students in the institution.
Ef_female_count:	The number of enrolled female students in the institution.
Ef_total_count:	The total number of enrolled students, combining both male and female counts.
Sector_cd:	A code indicating the institution's sector, such as public or private.
Sector_name:	The name of the institution's sector.
Partic_women:	The number of female participants in the sport or sports program
Partic_coed_men:	The number of male participants in co-ed (mixed-gender) sports.
Partic_coed_women:	The number of female participants in co-ed sports.
Sports:	The specific sport or activity (e.g., football, basketball) for which the data is being recorded.

Justification of Machine Learning Algorithms

- Logistic regression

Logistic regression is particularly well-suited for binary and multiclass classification, making it an excellent choice for predicting participation, whether as participation versus non-participation or participation in a specific discipline. It provides probabilities associated with each class, enabling the assessment of the likelihood that a student will participate in a given sports discipline. Its

simplicity and ability to avoid overfitting make logistic regression a high-performing model, especially in contexts where explanatory variables directly influence the probability of participation, such as sports preferences, available time, or the desired level of competition (Das, 2024).

- Decision trees

Decision trees will analyze the data by splitting features to classify students according to their probability of participating in each sports discipline. This model also identifies the most important variables for classification, making it easy to visualize the factors that most influence participation. Once trained, the decision tree can be applied to new data to predict a student's participation in a specific discipline based on their characteristics and preferences (Song, et al, 2015), (Schidler, et al, 2024).

Proposed approach

a) Data Preprocessing

Data Cleaning: In the data cleaning phase, handling missing values is crucial to maintaining the dataset's integrity and ensuring that analyses and models built on it are accurate. Here are some common approaches for handling missing values, along with guidelines for deciding which approach to use:

- **Mean/Median Imputation:** This method involves replacing missing values with the mean (or median) of the non-missing values in that column.
- **Label Encoding**: Label encoding assigns a unique integer to each category of a categorical feature.

b) Model Validation

In predictive modeling, validating the model is essential to assess its accuracy and reliability in real-world applications. For predicting student participation in sports, model validation ensures that the chosen algorithms generalize well to new data, beyond the specific samples used for training. In this study, several validation methods were applied to verify the performance of the predictive models and to minimize overfitting or underfitting.

- **Train-Test Split**:

A basic yet effective approach to validation is splitting the dataset into two parts: a training set, used to fit the model, and a test set, used to evaluate its performance. This method allows for a straightforward assessment of how well the model can make predictions on unseen data. Typically, an 80-20 split is used to ensure that the model has a sufficient number of samples for training while leaving enough data for robust testing.

- **Evaluation Metrics**:

To measure the predictive accuracy, several metrics were used (Rainio, et al 2024), including:

- **Accuracy**: The proportion of correctly predicted instances out of all predictions made. Accuracy is useful for an overall sense of correctness.
- **Precision:** Precision assesses the accuracy of positive predictions (i.e., the proportion of true positive predictions among all predicted positives),
- **Recall**: recall measures the ability of the model to capture all relevant positive cases. These metrics are particularly useful for understanding the model's performance on minority classes, such as groups of students with lower participation rates.
- **F1-Score**: This metric combines precision and recall into a single score, offering a balanced view of the model's performance. It is particularly helpful in scenarios where there is an imbalance in participation data across sports or student demographics.
- **Area Under the ROC Curve (AUC-ROC)**: This metric evaluates the model's ability to discriminate between classes across all decision thresholds, making it a robust choice for binary and multi-class classification tasks in sports participation prediction (Chang, 2024).

RESULTS

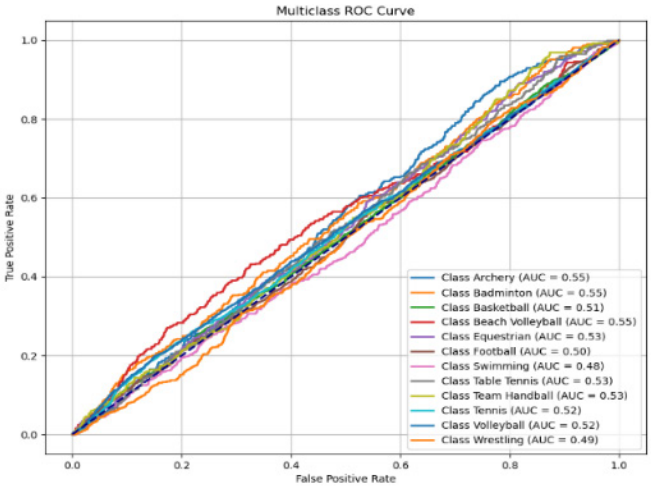

Figure 1. Logistic Regression ROC

Improving performance may require adjusting the model, adding more discriminative features, or using more sophisticated algorithms for this multiclass classification task.

Table 2. Regression Logistic Confusion Matrix

Classes	Precision	Recall	F1-score	Support
Archery	0.00	0.00	0.00	288
Badminton	0.00	0.00	0.00	337
Basketball	0.21	1.00	0.35	2006
Beach Volley	0.00	0.00	0.00	394
Equestrian	0.00	0.00	0.00	381
Football	0.00	0.00	0.00	1049
Swimming	0.20	0.01	0.03	562
Table Tennis	0.00	0.00	0.00	327
Handball	0.00	0.00	0.00	298
Tennis	0.00	0.00	0.00	1297
Volleyball	0.00	0.00	0.00	1757
Wrestling	0.00	0.00	0.00	648

Decision Tree

Figure 3 shows a Decision tree ROC curve for multiclass classification, evaluating the performance of a model across multiple classes (likely representing different sports disciplines). An interpretation of the results based on the AUC values is presented below:

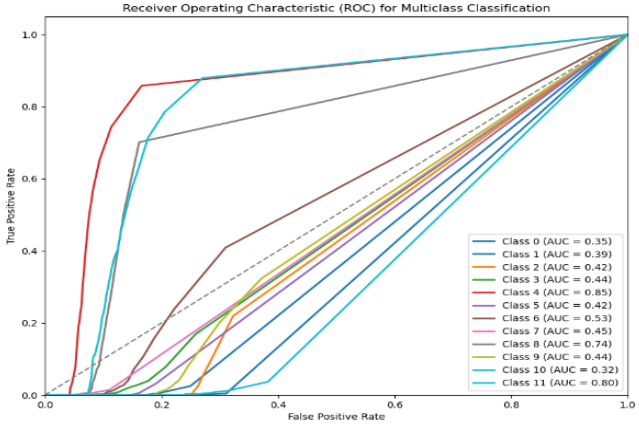

Figure 2. Decision tree ROC

Table 3. Confusion Matrix of Decision Tree

Classes	Precision	Recall	F1-score	Support
Archery	0.96	0.98	0.97	288
Badminton	0.99	0.99	0.99	337
Basketball	1.00	1.00	1.00	2006
Beach Volley	1.00	0.99	0.99	394
Equestrian	1.00	1.00	1.00	381
Football	1.00	1.00	1.00	1049
Swimming	1.00	1.00	1.00	562
Table Tennis	1.00	1.00	1.00	327
Handball	0.85	0.97	0.91	298
Tennis	0.99	0.96	0.97	1297
Volleyball	0.99	0.99	0.99	1757
Wrestling	0.97	0.97	0.97	648

DISCUSSION

Logistic Regression

Figure 2 shows a Logistic Regression ROC (Receiver Operating Characteristic) curve for multiclass classification of student participation across various sports disciplines. The interpretation of the results is below:

- **Individual ROC Curves for Each Class**:

Each colored curve represents a specific class (a sports discipline). The curves show the relationship between the True Positive Rate and the False Positive Rate for different classes within the multiclass classification framework.

- **AUC (Area Under the Curve) Values**:

The AUC measures the model's ability to distinguish between classes. The AUC values indicated in the legend for each class range from 0.48 to 0.55. An AUC close to 0.5 means that the model performs similarly to random guessing for that class. In Figure 2, the AUC values are close to 0.5 for all classes, which suggests that the model struggles to correctly predict participation for each sports discipline.

- **Performance Interpretation**:
  - A higher AUC (close to 1) would indicate good classification performance, but here, the low AUC values suggest that the model is not effective in accurately distinguishing between different classes.

- The low AUC values for all classes could be due to several factors, such as a lack of discriminative data for each sport, an unsuitable model, or suboptimal feature representation.
- **Axes and Visual Interpretation**:

The x-axis represents the False Positive Rate (the proportion of incorrect positive predictions), and the y-axis represents the True Positive Rate (the proportion of correct positive predictions). The gray diagonal line (dotted) represents the performance level of a random model. Curves that approach this line indicate that the model does not add significant value over random prediction.

In conclusion, the classification model does not appear to perform well in predicting student participation in different sports disciplines.

- **AUC Values and Model Performance**:
  - The AUC (Area Under the Curve) values vary significantly across classes, ranging from 0.32 to 0.80.
  - **Class 11** shows the highest AUC (0.80), indicating that the model performs relatively well for this class, distinguishing it more effectively from the others.
  - **Classes with low AUCs**, such as Class 9 (0.32) and Class 0 (0.35), indicate that the model struggles to differentiate these classes from others, performing only slightly better than random guessing.
- **Inter-Class Variability:**
  - The variation in AUC scores suggests that the model's ability to predict participation differs significantly between classes. Some classes are easier for the model to identify (e.g., Class 11), while others are challenging.
  - This variability could imply that certain classes may have more distinct or discriminative features in the dataset, while others overlap more with other classes, making classification harder.
- **Curve Shapes and Classification Quality:**
  - The closer the curve is to the top-left corner, the better the model's performance for that class. In this image, only a few curves approach this corner, indicating suboptimal model performance overall.
  - Many curves closely follow the diagonal (dotted line), which represents random classification, indicating that the model performs poorly for those classes.
- **Potential Model Improvements**:
  - The model may benefit from further tuning, feature engineering, or a more advanced classification algorithm to improve its ability to distinguish between all classes.
  - Additional or more distinct data for classes with low AUCs might help the model learn to differentiate them better.

In conclusion, overall, the model shows moderate success in predicting participation for a few classes (like Class 11).

CONCLUSION

In the context of promoting university sports activities in Algeria, this study proposed a machine learning-based approach to predict student participation in various sports disciplines. The primary objective was to identify the key factors influencing student engagement in sports, providing university decision-makers with decision-support tools to optimize sports policies and encourage more inclusive participation.

The machine learning models utilized, such as logistic regression and decision trees, demonstrated their effectiveness in predicting participants based on various demographic, academic, and sports-related characteristics. These results highlighted the most attractive disciplines and identified student groups most likely to engage in sports activities.

The proposed method offered a comprehensive understanding of sports preferences of Algerian students, contributing to better resource planning and tailored sports programs. Moreover, this approach represents a significant advancement for the university sports community by supporting data-driven decision-making and fostering the development of a dynamic and inclusive sports ecosystem within Algerian universities.

The findings emphasize the potential of machine learning as a strategic tool for analyzing student behaviors and improving university sports management practices. Future research could explore more diverse datasets and implement more complex models to further enhance the impact of this approach on the student sports community.

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THE PRESENCE OF SPORTS GAMES IN THE LIVES OF MIDDLE SCHOOL STUDENTS

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ABSTRACT. Leisure time is a precious resource in our busy and stressful lives, and how we spend it can have a significant impact on our physical and mental health. One of the popular ways to make use of leisure time and promote an active lifestyle is through engaging in sports games. This research theme focuses on the observational study of participating in sports games during leisure time, examining their benefits and impact on individuals and society as a whole. Engaging in sports games during leisure time offers a range of physical and mental advantages. Physically, it helps maintain optimal health by improving cardiovascular endurance, muscle strength, and flexibility. The present study included a total of 227 individuals who responded affirmatively to participating in this research and completing the proposed questionnaire, students in the seventh and eighth grades. The results obtained indicate a significant preference for team sports compared to individual sports, highlighting the importance of interaction and collaboration in sports activities. Popular sports games among preadolescents include soccer, basketball, and volleyball, which can be practiced in an accessible manner and in various locations. A significant percentage of preadolescents do not engage in sports activities regularly or dedicate very little time to them, which may indicate a trend towards a sedentary lifestyle. Sustained efforts are needed to increase preadolescents' awareness of the benefits of physical activity and sports games, as well as to promote more active involvement in these activities.

Keywords: *students, gymnasium, sports games*

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REZUMAT. ***Prezența jocurilor sportive în viața elevilor de gimnaziu*****.** Timpul liber este o resursă prețioasă în viața noastră agitată și stresantă, iar modul în care îl petrecem poate avea un impact semnificativ asupra sănătății noastre fizice și mentale. Una dintre modalitățile populare de a profita de timpul liber și de a promova un stil de viață activ este practicarea jocurilor sportive. Această temă de cercetare se concentrează asupra studiului constatativ al practicării jocurilor sportive în timpul liber, examinând beneficiile și impactul acestora asupra individului și societății în ansamblu. Practicarea jocurilor sportive în timpul liber oferă o serie de avantaje fizice și mentale. Din punct de vedere fizic, aceasta ajută la menținerea unei stări de sănătate optime, îmbunătățind rezistența cardiovasculară, forța musculară și flexibilitatea. În prezenta cercetare a fost cuprins un număr de 227 de persoane care au răspuns afirmativ în a lua parte la această cercetare și a completa chestionarul propus, elevi în clasele a VII-a și a VIII-a. Rezultatele obținute indică o preferință semnificativă pentru jocurile de echipă în comparație cu sporturile individuale, indicând importanța interacțiunii și colaborării în activitățile sportive. Jocurile sportive populare printre preadolescenți includ fotbalul, baschetul și voleiul, care pot fi practicate într-un mod accesibil și în diferite locații. Un procent semnificativ de preadolescenți nu practică activități sportive în mod regulat sau dedică foarte puțin timp acestora, ceea ce poate indica o tendință către un stil de viață sedentar. Este nevoie de eforturi susținute pentru a crește conștientizarea preadolescenților cu privire la beneficiile activității fizice și a jocurilor sportive, precum și pentru a promova o implicare mai activă în aceste activități.

Cuvinte-cheie: *elevi, gimnaziu, jocuri sportive*

INTRODUCTION

According to the specialized literature (Bergeron, 2013; Gould, 2019; Cucui, & Cucui, 2018; Corbin, & Pangrazi, 2015; Cucui, 2019; Tomaka, & Thompson, 2009; Cucui, 2020), engaging in sports games during leisure time offers a range of physical and mental benefits. Physically, it helps maintain optimal health, improving cardiovascular endurance, muscle strength, and flexibility. It also promotes better weight control and prevents numerous conditions such as obesity, heart disease, and type 2 diabetes. On the other hand, the mental benefits of engaging in sports games during leisure time are remarkable. These include stress and anxiety reduction, improved mood, and increased energy levels. Sports can also contribute to the development of social skills, increased self-confidence, and character building.

Sports games provide students with valuable opportunities to learn and practice physical skills necessary for developing and maintaining lifelong physical health. Beyond health benefits, physical education also fosters a type of knowledge and understanding based on rules and respect, promoting social awareness through social interaction.

Through sports games, students learn not only about movement and fitness but also values such as fair play, teamwork, respect for others, and sports discipline. These values help them develop as responsible individuals and contribute to their formation as active members of society.

Besides individual aspects, engaging in sports games during leisure time also has a significant impact on the community and the surrounding environment. These activities encourage social interaction and promote cohesion among people. They can serve as a catalyst for forming friendships and strong interpersonal relationships, as well as for building healthier and more united local communities.

Like art and culture, recreation, leisure, and sports activities play an essential role in communities. Their numerous benefits include improving individual health and well-being, contributing to individual empowerment, and promoting the development of inclusive communities. Recreational, leisure, and sports activities can engage individuals, small groups, teams, or entire communities and are relevant to people of all ages, abilities, and different skill levels. The types of recreational, leisure, and sports activities in which people participate vary greatly depending on the local context and tend to reflect social systems and cultural values (Lucaciu, 2004). Through sports games, individuals learn and develop motor skills, coordination, strength, endurance, and flexibility.

Sports games have a strong social character. They can create a bond between individuals and the community, facilitating social integration, communication, and interaction with others. Organizing sports competitions and community sporting events can promote fair play, respect, and solidarity among participants.

Moreover, engaging in sports games during leisure time can contribute to environmental protection. Activities such as mountain hiking, cycling on natural trails, and canoeing on lakes or rivers provide an opportunity to connect with nature and develop a sense of responsibility and awareness toward the environment.

By practicing physical and sports activities, the goal is to improve individual health while developing motor, social, and cognitive skills, thus contributing to an active and balanced life.

Therefore, this observational study focuses on exploring and gaining a deeper understanding of engaging in sports games during leisure time. By obtaining clear and relevant results, we can promote an active, balanced, and healthy lifestyle for individuals and society as a whole.

OBJECTIVE

The primary objective of this observational study is to investigate and analyze the practice of sports games during leisure time, the frequency and duration of their practice, the associated physical and psychological benefits, as well as potential obstacles or barriers encountered in the regular practice of these activities.

METHODS

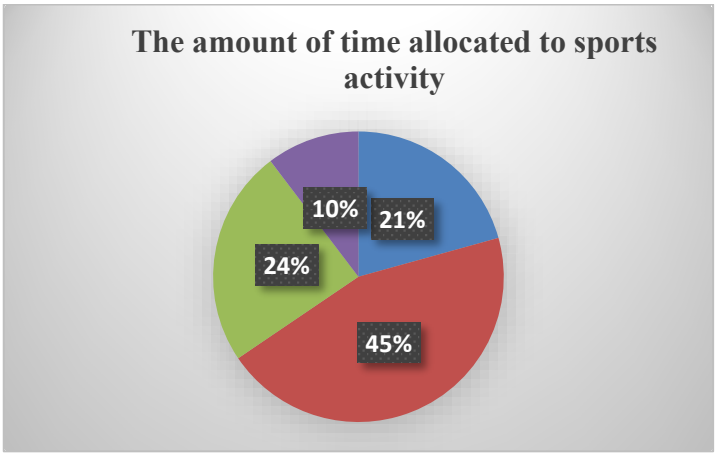
The research activity took place in the Municipality of Târgoviște during the 2022-2023 school year. The sample included 227 seventh and eighth grade students who voluntarily expressed their opinions by completing the proposed questionnaire, which included items to identify practiced sports games, factors influencing participation in sports games during leisure time, and potential barriers or obstacles to their practice.

To construct, organize, and present this research, the following methods were used: the bibliographic study method, the survey-based questionnaire method, the statistical-mathematical method, and the graphical method.

RESULTS

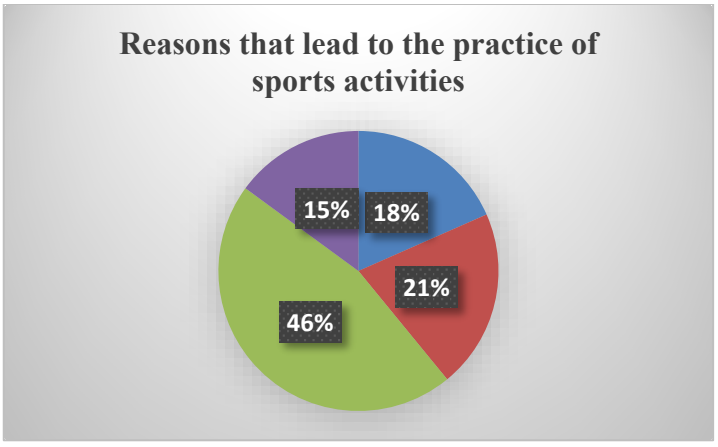
After administering the questionnaires, data were compiled and interpreted. In response to the question, "What sports activities do you prefer in your leisure time?" most of the subjects involved in the research indicated sports games that do not require high costs and can be easily practiced in various locations with minimal sports facilities. Football ranked first, being the most popular sport worldwide, followed by basketball and volleyball. Swimming was the next most practiced and preferred individual activity. Additionally, students mentioned athletics and handball as leisure activities. The wide range of practiced sports games is encouraging and highlights the need for preadolescents to engage in physical activity.

Regarding the weekly time allocation for sports activities, a concerning aspect emerged: 21% of respondents engage in sports games less than once a week, and 45% only once a week. Meanwhile, 24% practice sports activities twice a week, while only 10% engage in such activities three or more times per week.



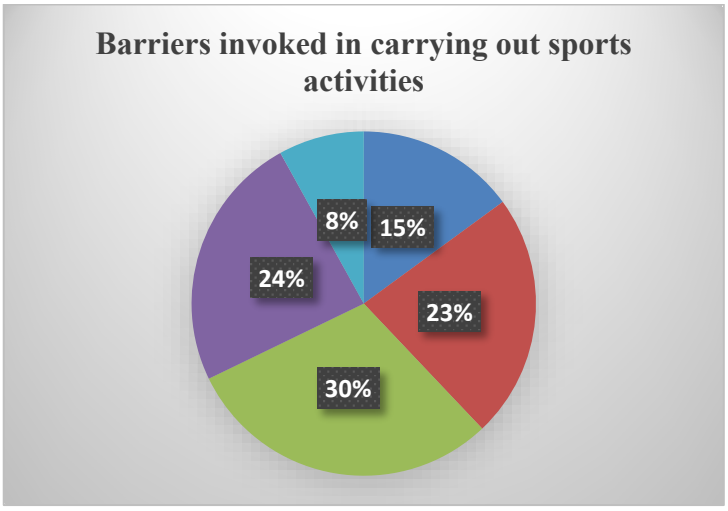
Graph 1: The amount of time allocated to sports activity

When asked, "What factors encourage or facilitate engaging in sports games during leisure time?" 46% of students responded that participating with friends was the main reason for engaging in these activities. This further underscores the importance of sports activities in the lives of preadolescents and adolescents as a regulatory factor for the hormonal changes they experience at this age. Additionally, 18% considered parental guidance as a motivating factor, while 21% cited infrastructure availability as an important reason for practicing sports games. This highlights the need for investments in equipping and upgrading sports facilities in local communities to attract more young people to an active lifestyle. Only 15% of respondents stated that sports games are part of their weekly routine, which is both encouraging and motivating for others.



Graph 2: Reasons that lead to the practice of sports activities

When asked about "the main barriers or difficulties in engaging in sports games during leisure time," students indicated lack of motivation and the high cost of equipment as the primary obstacles. Additionally, 15% cited a lack of time, which is understandable given that eighth-grade students focus on their final exams. Excess weight accounted for a relatively small percentage (8%), but it remains concerning regarding the physical condition of today's preadolescents. Furthermore, 30% of surveyed students reported a lack of sports infrastructure as another significant challenge, while 24% cited lack of motivation.



Graph 3: Barriers invoked in carrying out sports activities

DISCUSSIONS

It is essential to focus on educating and raising awareness among preadolescents about the benefits of physical activity and sports games for their overall health and development. This can be achieved by introducing physical education and health programs in local communities, organizing discussions and presentations within school programs, and involving parents and teachers in promoting an active lifestyle.

Offering a variety of sports activities is crucial so that preadolescents can find something that attracts and motivates them. Additionally, sports games that do not require high costs and can be practiced in various locations should be encouraged.

Local authorities should invest in developing and improving sports infrastructure, including setting up sports fields and spaces in parks, schools, and communities, to ensure easier access to appropriate facilities for physical activities.

CONCLUSIONS

The impact of sports games on the leisure time of preadolescents is highlighted by the results obtained, demonstrating the need for effective interventions and programs to promote physical activity and a healthy lifestyle.

Movement and participation in sports activities are important for preadolescents, bringing numerous benefits to their health and physical and social development.

Interaction and collaboration in sports activities are considered more important in team games than in individual ones, according to significant personal preferences. Football, basketball, and volleyball are popular sports among preadolescents, as they are accessible and can be practiced in various locations.

A significant proportion of preadolescents do not engage in sports regularly or dedicate very little time to them, which may indicate a tendency toward a sedentary lifestyle.

Key factors for preadolescents' involvement in physical activities include adequate sports infrastructure and the availability of spaces for these activities.

Some obstacles to practicing sports games include a lack of motivation, expenses for equipment, lack of time, health issues, or excess weight.

Preadolescents need sustained efforts to increase their awareness of the benefits of physical activity and sports games and to become more engaged in these activities.

In promoting physical activity and a healthy lifestyle among preadolescents, the development of sports infrastructure and the creation of appropriate programs and policies at the local level can play an important role.

The conclusions of this study can serve as a foundation for identifying needs and developing appropriate strategies and interventions to promote physical activity and sports participation among preadolescents.

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