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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 well-documented benefits of sports, barriers such as academic pressures and inadequate infrastructure hinder student involvement. This study employed a machine learning-based approach to predict sports participation among Algerian university students. Logistic regression and decision tree models were applied to analyze the dataset, focusing on key factors such as gender and athletic background. The models effectively predicted participation patterns, identifying gender and athletic background as significant determinants. Additionally, the analysis highlighted the most attractive sports disciplines for students, facilitating improved resource allocation and program design. The findings underscore the potential of machine learning to enhance university sports management. By providing actionable insights, this approach can guide the development of inclusive policies, fostering a dynamic and accessible sports ecosystem in Algerian universities.

Keywords: machine learning, prediction, sport, student participant

Introduction

Universities play a crucial role in fostering student socialization by fostering an environment that encourages exchanges and social interactions, particularly through sports activities. By offering opportunities to practice 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 et 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.

University sports will ensure the alignment of athletic achievements to enhance the physical potential of younger generations through physical exercise (Wang, 2016) which is the primary and most effective means for this transformation. University sports hold a crucial place in students' academic and social journey,

playing a vital role in their physical, mental, and social development (Eime, 2013). Within universities, sports are not merely leisure activities but 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 few 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 prompts us to investigate the reasons behind the limited participation and the factors that shape students' decisions to participate in or refrain from university sports. Therefore, it is relevant to conduct an in-depth study to analyze students' sports habits, understand perceived motivations and obstacles, and ultimately predict students' participation profiles (Hoffmann, 2009). By identifying these factors, this research aims to contribute to developing tailored strategies that encourage broader sports participation within Algerian universities, thereby enabling students to fully benefit from the advantages of physical activity and university life (Andrews, 2005, Brady, 2005).

The supervised or unsupervised learning (Bishop, 2006) used in this context will enable us to predict student participation based on many variables such as gender, age, sporting background, preferences for some disciplines, and even perceptions of the benefits of practicing sports. Based on complex data analysis (Chawla, 2024), this approach 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 practical strategies to encourage better and more inclusive participation in university sports activities.

Influence of Social Group: Social surroundings, including friends and family, play an essential role in a student's decision to participate in sports activities (Dishman et al., 2005). Additionally, cultural norms and social expectations of each country or institution often influence participation. Studies have shown that men participate more frequently in university sports activities than women, although this difference tends to decrease in specific contexts (Browne et al., 2013). However, factors such as the perception of social acceptance of women's sports and the availability of resources can influence female students' engagement. Access to sports facilities and their quality directly impact student participation. Studies have highlighted that quality and easily accessible facilities encourage more students to engage in sports (Eime et al., 2013). The existence of diverse sports programs and the involvement of universities in promoting sports are also key factors. Some universities offer flexible schedules, sports clubs, and competitive events to encourage participation (Trost et al., 2002).

Numerous studies in the social sciences, physical education, and psychology have examined university sports participation (Zhou, 2024). These studies have mainly sought to understand the factors influencing students' engagement in university sports activities and the consequences of this participation on their personal, social, and academic development.

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Materials and methods

Data description

This dataset contains comprehensive information on university sports programs across various institutions in Algeria (Algerian, 2024). It includes data on student enrollment and sports participation categorized by gender and sport. The dataset can be used to analyze trends and gender disparities in university sports.

This dataset contains comprehensive information about university-level sports programs across institutions in Algeria, capturing student enrollment and sports participation by gender (Kotsiantis, 2004). Each row represents a unique record for a specific institution in a particular year, detailing the demographic of sports programs. This dataset can analyze trends in university sports and evaluate gender disparities in participation within Algerian universities' sports programs. The attributes are organized into several categories (Table 1).

The dataset provides a comprehensive overview of various aspects of university sports participation and enrollment. Firstly, institution information includes unique identifiers such as united and institution_name to distinguish each university. Additionally, location details such as (city_txt, state_cd, and zip_text) provide the geographical context of each institution. Secondly, classification data categorizes universities based on attributes such as size, focus, or sports participation levels, as represented by (classification_code, classification_name, and classification_other). The dataset also includes sector information (sector_cd and sector_name), which specifies whether the institution is public or private. Thirdly, enrollment data offers gender-specific enrollment figures. These include male (ef_male_count), female (ef_female_count), and total enrollment counts (ef_total_count) for each institution. Finally, the dataset captures detailed sports participation information. Sports program details are identified using sports_code and sports, indicating the types of sports offered. Gender-specific participation is documented through partic_men, partic_women, partic_coed_men, and partic_coed_women, capturing male, female, and mixed-gender team participants. Furthermore, total participation counts for men and women are summarized in sum_partic_men and sum_partic_women across all sports programs.

This structure provides a rich dataset for analyzing patterns in university enrollment and sports participation.

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.

Machine Learning Algorithms

Logistic regression is particularly well-suited for binary and multiclass classification. It is an excellent choice for predicting participation, whether as participation versus non-participation or involvement 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 will analyze the data by splitting features to classify students according to their participation probability in each sports discipline. This model also identifies the most critical variables for classification, making it easy to visualize the factors most influencing participation. Once trained, the decision tree can be applied to new data to predict a student's involvement in a specific discipline based on their characteristics and preferences (Song et al., 2015), (Schidler et al., 2024).

Methodology steps

Data preprocessing

In this phase, handling missing values is crucial to maintaining the integrity of the dataset and ensuring that analyses and models 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.

Model validation

Validating the model is essential in predictive modeling 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 predictive models' performance and minimize overfitting or underfitting.

Train-Test Split: A basic yet practical 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

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how well the model can predict unseen data. Typically, an 80-20 split is used to ensure that the model has sufficient 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 beneficial 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 beneficial in scenarios with imbalanced 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 and discussions

Logistic Regression

Figure 1 illustrates the Receiver Operating Characteristic (ROC) curve for multiclass classification, demonstrating the performance of a logistic regression model in predicting student participation across various sports disciplines. Each colored curve corresponds to a specific class, representing the relationship between the True Positive Rate (TPR) and the False Positive Rate (FPR) for different sports disciplines. The diagonal gray line serves as a reference, indicating the performance of a random model; curves closer to this line suggest limited predictive ability.

The model's performance is further quantified using the Area Under the Curve (AUC) values, which measure the model's ability to distinguish between classes. In this case, the AUC values, ranging from 0.48 to 0.55, reveal a performance close to random guessing. These results highlight the model's difficulty in accurately classifying student participation for individual sports disciplines. The low AUC values raise concerns about the model's effectiveness, which could stem from various factors. Possible reasons include insufficiently discriminative data for each sports discipline, an unsuitable model choice, or suboptimal feature representation. Such limitations suggest that the model may require refinement or additional data preprocessing to improve its predictive capabilities.

The axes of the ROC curve provide further insight into the model's performance. The x-axis represents the False Positive Rate, capturing the proportion of incorrect positive predictions, while the y-axis represents the True Positive Rate, indicating the proportion of correct positive predictions. The proximity of the curves to the diagonal line confirms the model's inability to add significant value beyond random prediction.

In conclusion, the logistic regression model demonstrates limited effectiveness in predicting student participation across sports disciplines. The results underscore the need for further investigation to enhance the model's ability to distinguish between classes and improve its overall performance.

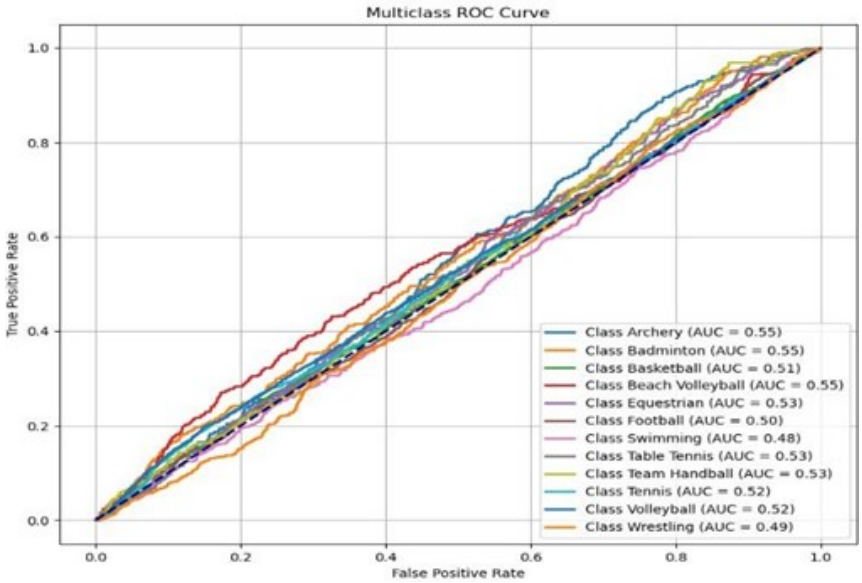

Figure 1. Logistic Regression ROC

Table 2 presents the confusion matrix for the model's performance for Logistic Regression model across multiple classes. The confusion matrix provides a detailed view of how well the model classifies instances into the correct categories. Each row in the matrix corresponds to an actual class, while each column represents a predicted class.

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

The ROC curve for the decision tree model (Schidler, 2024), as shown in Figure 2, evaluates the performance of multiclass classification, likely representing various

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sports disciplines. The analysis of AUC (Area Under the Curve) values provides insight into the model's effectiveness across different classes.

The AUC values reveal significant variation across classes, ranging from 0.32 to 0.80. Notably, Class 11 achieves the highest AUC value of 0.80, indicating the model's strong performance in distinguishing this class from others. Conversely, classes such as Class 9 and Class 0, with AUC values of 0.32 and 0.35 respectively, demonstrate the model's struggle to differentiate these categories, performing only marginally better than random guessing. This variability in AUC scores highlights the model's differing levels of accuracy between classes. For instance, the higher performance in certain classes, like Class 11, suggests the presence of more distinct or discriminative features in the dataset. On the other hand, lower-performing classes may overlap significantly with other categories, posing challenges for the model.

The shapes of the ROC curves further reflect classification quality. Curves that approach the top-left corner signify better performance, yet in this case, only a few classes achieve this benchmark. Many curves closely align with the diagonal, indicating poor classification performance for those classes.

To enhance the model's predictive accuracy, several improvements could be considered. Fine-tuning the model, performing feature engineering, or employing more advanced classification algorithms might address current limitations. Additionally, obtaining more representative or distinct data for underperforming classes could help the model better differentiate between categories.

In conclusion, while the model demonstrates moderate success in predicting participation for certain classes, such as Class 11, its overall performance remains suboptimal, particularly for classes with low AUC values. Future enhancements could significantly improve its utility in this multiclass classification task

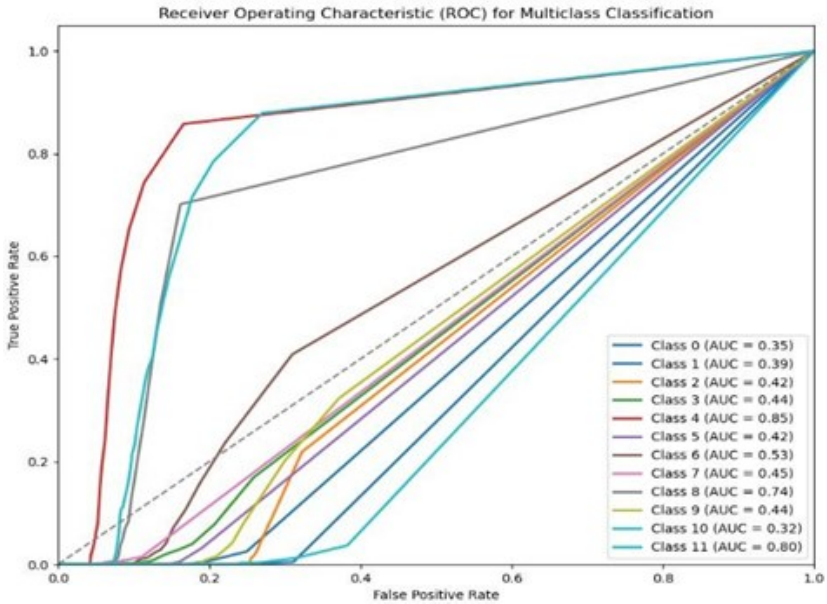

Figure 2. Decision tree ROC

Table 3 presents the confusion matrix for the model's performance for Decision Tree model across multiple classes. The confusion matrix provides a detailed view of how well the model classifies instances into the correct categories. Each row in the matrix corresponds to an actual class, while each column represents a predicted class.

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

Conclusions

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 the 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 role and importance of the physiotherapists in educational institutions

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Abstract: This research aimed to introduce at least one physiotherapist in the interdisciplinary team of the schools, including teachers, doctors, dentists, psychologists, psychotherapists, and auxiliary staff, for the assessment and, if necessary, the periodic postural treatment of the students. The study included 25 students aged between 16 and 18, of which 12 were female and 13 were male. The subjects were divided as follows: 13 students represented the experimental group, and the other 12 constituted the control group. Individuals from the first group followed an individualized kinetic program, and those from the second group followed Physical Education classes within the educational unit. The final results of the research confirmed the hypothesis of our study, namely, the subjects in the experimental group who followed a personalized rehabilitation program developed by a pediatric physical therapist, which contains specific exercises to correct postural deformities for whole body prophylaxis, obtained significantly better results in terms of posture compared to the subjects in the control group who followed the Physical Education class in the school curriculum. Following the initial assessment at the beginning of the study, we concluded that students show multiple postural variations that could be prevented in educational establishments in the presence of at least one pediatric physiotherapist.

Keywords: physiotherapy, physical activity, educational units, physical activity, kinetic prophylaxis

Introduction

Movement represents a physiological category that designates the totality of movements and changes made by living and non-living matter in the universe. Human movement is a reflex, automatic or voluntary act, which consists of changing the whole body's position or a part. It is performed due to concentric or eccentric and dynamic muscle contractions. The production of positive mechanical work accompanies concentric dynamic contractions; the negative one is present during eccentric dynamic contractions.

Pediatrics represents the medical science that has been the field of study of the human body from birth to adolescence from the point of view of development and the pathologies that may appear during this period.

Prophylaxis represents all the means implemented to avoid, expand or worsen certain diseases. A medical-sanitary ensemble is used to prevent certain diseases. Prophylactic treatment measures are used in modern medicine because the chance of success increases considerably, and it is not less expensive from a financial point of view compared to curative treatment (Mârză-Dănilă, 2012).

The purpose of kinetic prophylaxis is to strengthen the state of health, increase the body's natural resistance to pathogens of the external environment, determine a normal psycho-physical balance between the body and the environment, and for children, ensure the conditions for harmonious and normal growth and development of the body, preventing the appearance of physical deficiencies and contact with pathogens that could affect their normal development (Roşulescu et al., 2007; Chang, 2022).

Physiotherapists are specialized medical staff trained to identify and correct the body's biomechanical and anthropometric deficiencies (Szabo et al., 2023). Pediatric physiotherapists work with children from birth to adulthood. They know the stages of development, the evolution of movements concerning advancing age and possible deviations from them (Chang, 2022).

Adolescence is generally considered a healthy period; many of the non-communicable diseases that manifest later are, in part, the result of modifiable risk behaviors established during this period, such as smoking, unhealthy eating patterns, and low levels of physical activity (Balint, 2010; van Sluijs et al., 2021).

Physical inactivity is often associated with later non-communicable diseases. This is recognized as a global pandemic (Kohl et al., 2012), with most evidence coming from studies of adults when the effects of NCDs become apparent (Gore et al., 2011). The World Health Organization recommends that adolescents and children up to 18 years of age do, on average, 60 minutes a day of moderate to vigorous physical activity. People over 18 should perform between 150-300 minutes of moderate or 75-150 minutes of intense physical activity (Bull et al., 2020).

Regular physical activity at any age improves the formation and expansion of new blood vessels in the brain and the increase of neurotrophic factors that support neuronal birth and proliferation (Sleiman et al., 2016; Miranda et al., 2019). Specifically, levels of brain-derived neurotrophic factor (BDNF), a protein associated with changes in learning, memory, mood, and anxiety, were found to increase in response to exercise due to increased production of component molecules that comprise the BDNF protein.

Given rapid growth and myelination during adolescence, neural mechanisms strengthened by physical activity may support fine-tuning cognitive functions that promote learning and memory processes. Physical activity also has immediate direct effects on the adolescent brain, including increased mean cerebral blood flow and increased plasma levels of key neurotransmitters linked to increased arousal, all of which may support improved cognitive functioning (McAuley et al., 2004; Querido & Sheel, 2007).

Beyond neurocognitive benefits, physical activity also profoundly benefits psycho-emotional outcomes among preschoolers, children, and adolescents (Rodriguez-Ayllon et al., 2019). Focusing on teenagers, those who engage in more physical activity than their peers report experiencing less anxiety, depression, and other mood disorders; they also stated that self-esteem and self-concept are higher compared to colleagues who did not perform physical activity (Spruit et al., 2016; Chen et al., 2017; Mandolesi et al., 2018; Belcher et al., 2021).

Endogenous and exogenous factors act with a specific rhythm that induces a certain rhythm of growth and development, presenting a characteristic speed of the process with periods of acceleration and deceleration. These processes of influencing development and growth agents are carried out by defining energy consumption for each process, moment, stage or phase.

Heredity is the transmission of certain traits and characteristics from ancestors to ancestors. The characteristics that can be transmitted through heredity and can be of a constitutional nature: height, body mass, hair texture, eye color; of a psycho-behavioral nature: intelligence, creativity, personality; of a sanogenic or pathogenic nature: diabetes, obesity, cardiovascular diseases: arterial hypertension; or they may be related to motor skills that are influenced by neuro-hormonal processes and the body's metabolism (Balasundaram & Avulakunta, 2023).

Endocrine factors are represented by hormonal processes that have variable influence during development.

Secreted by the thyroid gland, thyroid hormones ensure the normal functioning of the body by regulating the body's metabolism and internal organ functions. Through the bloodstream, they traverse the body and support cells to convert calories and oxygen into energy, which essentially influences every cell, tissue, and internal organ of the human body (Benyi & Sävendahl, 2017).

Somatotropic hormones control the growth of the body until the age of 10 years. After this period, the anterior pituitary gland determines, through these hormones, protein synthesis, body weight, and growth in bone length and thickness. Pituitary gigantism and dwarfism represent two pathologies determined by pituitary somatotropic hyperfunction and hypofunction, respectively (Kato et al., 2002).

Gonadotrophins or sex hormones have a predominant influence during puberty, and this is divided into two distinct stages, namely the general stimulation of growth and physical development phenomena; respectively, the second stage is represented by the stopping of the growth process by strengthening the epiphyses and ossification of growth cartilages located in the border area between diaphyses and epiphyses (Graber et al., 2021).

Metabolic and nutritional factors are the internal factors necessary for developing all metabolic and nutritional processes in the human body. They ensure caloric, protein, lipid, carbohydrate, vitamin and mineral intake. Various morphological or functional dysfunctions can occur due to the lack of nutrients. They can represent the involution of growth and development processes (Balasundaram & Avulakunta, 2023).

The family environment exerts a marked influence on the child's perception of the outside world. It helps build the self-concept and trains it for actions in society. The child learns through interaction with parents and other family members in this

environment. In the first years of development, the family environment modulates the individual's behaviors. Normal development occurs in a supportive, harmonious and warm environment; in the case of a stressful environment, broken families or careless parents, children can develop as maladjusted persons (Horton & Wedding, 2008).

Human posture is generally understood as the relationship between the parts of the human body in an upright position. Certain parts of the body, such as the head and neck, the trunk, and the upper and lower limbs, are involved in the final posture of the body. A good body posture is considered ergonomically advantageous during standing, mechanically efficient during locomotion, and supportive of the normal functioning of internal organs (Czaprowski et al., 2018).

Body posture is described and considered in three reference planes: sagittal, coronal and transverse. Good posture is a state of muscular and skeletal balance that protects the body's supporting structures against injury or progressive deformation, regardless of the posture in which these structures work or rest. In such conditions, the muscles will work most efficiently, and the optimal positions are provided for the thoracic and abdominal organs (Kendall et al., 2005).

The most common deformations of the posture in the sagittal plane in both children and adults are lumbar hyperlordosis, thoracic kyphosis, flat back, where the physiological curves of the spine are missing, and forward projection of the pelvis (Sahrmann, 2002; Janssen et al., 2011; Comerford & Mottram, 2012).

To fulfill the objective of this work, we needed therapeutic tools such as mattresses, gym benches, balls, cones, and hoops. The primary method used in the study is therapeutic physical exercise. Stretching exercises, passive, passive-active, and active mobilizations, taping, therapeutic massage, and trigger point therapy are other methods used in the study. Therapeutic exercise involves prescribed movements to correct impairments, restore muscle and skeletal function, and/or maintain a state of well-being (Bielecki & Tadi, 2022).

Stretching is a therapeutic method by which the stretching of soft tissues is achieved beyond the limit point of the active range of motion and maintaining or not this stretching over a certain period. With its help, the undulations of the collagen fibers are stretched. We mean soft tissue, muscle tissue, contractile, fibrous skeleton, non-contractile, and other non-contractile structures, such as the joint capsule, tendons, ligaments, and skin.

The benefits of stretching are reducing stress and physical relaxation, increasing flexibility and muscle strength, improving posture, preventing injuries, cramps and muscle pain, and improving physical performance (Matthews, 2016). The types of stretching are as follows: passive stretching (Nelson & Kokkonen, 2021), isometric stretching (Ullman et al., 2021), dynamic stretching (Lin et al., 2020), ballistic stretching (Nelson & Kokkonen, 2021) and sports stretching (Matthews, 2016).

Kinesio taping is a treatment modality based on the body's natural healing process. This technique manifests its effectiveness by activating the neurological and circulatory systems. Kinesio taping comes from the science of kinesiology, which recognizes the importance of body movement and its segments in rehabilitation.

Excluding the role of muscles in the movement of body segments and the whole body and in maintaining posture, they also control the circulation of venous and lymphatic flows and maintain body temperature (Kase, 2010).

Massage is a complex of manual maneuvers systematically and methodically applied to body parts to obtain physiological, prophylactic, and therapeutic effects (Diaconu, 2015). This research aimed to introduce at least one physiotherapist in the interdisciplinary team of the schools, including teachers, doctors, dentists, psychologists, psychotherapists, and auxiliary staff, for the assessment and, if necessary, the periodic postural treatment of the students. The main objective of this research is to achieve wellness by applying prophylactic or recuperative programs within an educational institution, thus increasing the quality of life of the people who have benefited from them. Acting at a pediatric level will have positive repercussions on the adults of "tomorrow", reducing the pressure on the medical sector for recovery among adults. The paper is the first study on this topic and presents many novel elements. The study touches on key points such as postural imbalances among students and their correction in educational institutions. Another topic in this paper is how to prevent these static changes through kinetic programs to ton the back, chest and abdominal muscles.

Materials and methods

In the present research, we started from the hypothesis that following the program elaborated by us, one with a therapeutic and prophylactic purpose, the experimental group subjects will obtain better results from the postural point of view and the Harvard test compared to the subjects from the control group.

The type of study is longitudinal and is carried out to investigate a possible causal relationship between a risk factor and the occurrence of a disease, in our case, the relationship between physical therapy and postural deficiencies of students.

The research was carried out for 2 months, April 1 - June 1, 2023. The place of research was Theoretical High School "Constantin Noica" Sibiu.

The study included 25 students aged between 16 and 18, of which 12 were female and 13 were male. The group of subjects was divided as follows: 13 students represented the experimental group, and the other 12 constituted the control group. Individuals from the first group followed an individualized kinetic program, and those from the second group followed Physical Education classes within the educational unit.

The inclusion criteria were as follows: the subjects participating in the research had to be 11th-grade students of the Theoretical High School "Constantin Noica" Sibiu; it was mandatory that the subjects had parental consent and had no contraindications concerning the effort made during physical education and sports classes, given by the family doctor.

Exclusion criteria: subjects who did not receive a certificate from their family doctor that they could perform physical activity and those from whom parental consent was not obtained were excluded from the study.

The 25 subjects underwent a questionnaire on daily habits and periodic assessments: initial, intermediate and final. The experimental group, consisting of 13 randomly chosen subjects, followed a personalized rehabilitation plan after the first

assessment results. Along with their evolution, the program changed according to the subjects' needs and the intermediate evaluation results. At the same time, the control group followed the school curriculum for physical education classes.

The multidisciplinary team consisted of a doctor, a nurse from the school office, teachers, and a physiotherapist. The study's conduct, objectives and purpose were explained to all participants in advance. All 25 subjects who participated in the present study, both passively and actively, have the consent of their parents/legal guardians.

The management of the Theoretical High School "Constantin Noica" Sibiu agreed with the conduct of our research, and the collaboration was bilaterally excellent.

The study was carried out with the approval of the ethics committee of the University of Medicine, Pharmacy, Sciences and Technology "George Emil Palade" Târgu Mureș (Decision of the Ethics Committee of Scientific Research, No. 2256 of 06.04.2023) and all procedures were carried out in compliance with the requirements of the World Medical Association's Declaration of Helsinki and good clinical trial practice.

Tests used

The Harvard Maximal Effort test

It is used to measure the aerobic capacity of individuals, being a predictive test of VO_2max. The cardiovascular system is tested, thus reflecting the body's general ability to react to increased physical work and its ability to recover from exertion (https://www.physio-pedia.com/Harvard_Step_Test).

Equipment used: timer, metronome, exercise ladder/gym bench.

Conducting the test: The individual is prepared for the test; the assessor explains the procedure and asks for the testee's consent. Once his consent is obtained, the evaluator records his pulse. Begin the test by going up and down the exercise ladder at a rate of 30 ascents/descends per minute for 5 minutes. If the assessed individual can no longer perform the effort to the metronome's rhythm, the test is suspended, and the time of the effort performed is noted. Immediately after the effort, the pulse is determined in 3 periods: P1 the first 30 seconds after the effort, P2 the first 30 seconds of the 2nd minute and P3 in the 3rd minute, the first 30 seconds.

Anthropometric assessment

A. Height measurement

B. Chest circumference measurement

C. Measurement of abdominal circumference

Questionnaire on habitual habits

This questionnaire was used to observe whether there is a connection between the results obtained during the initial evaluation and the habits of the subjects.

The subjects answered questions regarding using personal belongings and transport objects, the consumption and amount of fast food, tobacco, alcohol, and caffeinated beverages, and the practice of physical exertion and frequency.

Results

Questionnaire about usual activities and habits

The questionnaire consisted of 25 questions aimed at discovering the activities of each individual participating in the study.

Respondents were asked to respond if they use a bag or backpack; the answers were: 19 respondents (76% of the total) use backpacks and 6 persons (24% of the total) use a backpack, 16 of them (84%) on both shoulders and 3 of them (16%) on one shoulder.

Respondents were asked if they eat fast food, and the answers were: 23 persons yes (92%) and 2 persons no (8%), 1-2 times a week 18 persons (78%) and 3-5 times 5 persons (22%).

Also, they were asked if they smoke, and the answers were: no – 10 persons, occasional – 6 persons and yes – 9 persons (89%), half a pack of cigarettes – 8 persons, one pack of cigarettes 1 person (11%).

Regarding the use of alcohol, the respondents answered: don't drink at all – 6 persons, drink occasionally – 17 persons, drink often – 2 persons; 1-2 glasses – 16 persons (84%), 3-5 glasses – 3 persons (16%).

Statistical processing

Descriptive and inferential statistics (median, mean and standard deviation) were included in the statistical analysis. The Kolmogorov-Smirnov normality test was applied to see to what extent our data follow a particular distribution. The Grubbs test was used to determine the outliers and the T-student test for unpaired data was applied to compare means. The Mann-Whitney test was utilized to correlate medians for unpaired data. Finally, the Anderson-Darling test was used to obtain descriptive statistics of the Harvard Test results. Minitab was applied for statistical analysis (Minitab 20.3, LLC, 2021).

Thirteen subjects were included in the study in the experimental group (16.92 ± 0.49 years old), and the control group was composed of 12 subjects (17 ± 0.42 years old). Following the Kolmogorov-Smirnov normality test (Table 1) applied to the two samples included in the research, we obtained statistical significance in both groups, with a p-value <0.05.

Table 1. Kolmogorov-Smirnov normality test results

	Experimental Group	Control Group
Mean	16.92	17
St Dev	0.4935	0.4264
KS	0.408	0.417
P value	<0.05	<0.05

*KS= Kolmogorov-Smirnov normality test

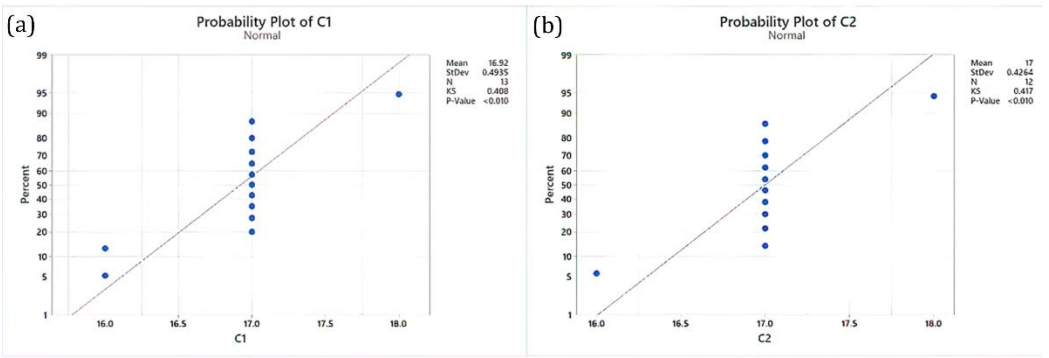

Figure 1. The results for EG (a) and for CG (b)

The p-value<0.05, thus resulting in a statistically significant difference (Table 1 and Figures 1a and b).

Table 2. Grubbs test results

	Experimental Group	Control Group
No.	13	12
Mean	16.923	17.000
ST.Dev	0.494	0.426
Min	16	16
Max	18	18
G	2.18	2.35
p-value	0.195	0.073

*G= Grubbs test

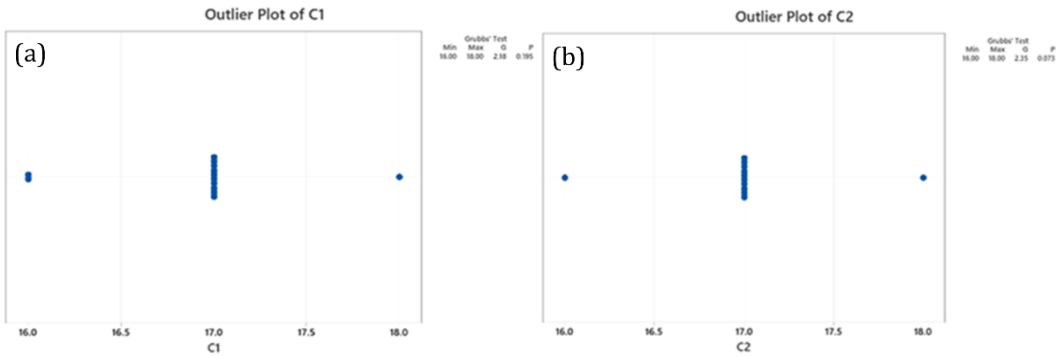

Figure 2. Grubbs test results for EG (a) and for CG (b)

The p-value > 0.05 resulted in the test not showing a statistically significant difference in the difference reported for each group (Table 2 and Figures 2a and b).

Table 3. Height results

	Experimental Group		Control Group
No.	13		12
Mean	96.92		95.7
ST Dev	6.85		16.7
t value T-test		0.24	
p-value T-test		0.812	

w value M-W	163.50
p-value M-W	0.348

*Mann-Whitney test; Equal variances are not assumed for this analysis.

The p-value > 0.05 means the test does not show a statistically significant height difference between the two groups (Table 3).

Table 4. Chest perimeter results

	Experimental Group		Control Group
No.	13		12
Mean	88,85		90,7
ST Dev	8,69		12,3
t value T-test		-0,42	
p-value T-test		p<0.05	

Equal variances are not assumed for this analysis.

The p-value < 0.05, thus resulting in the test showing a statistically significant difference in the difference in chest perimeters of the two groups (Table 4).

Table 5. Abdominal Perimeter results

	Experimental Group		Control Group
No.	13		12
Mean	72,69		76,1
ST Dev	8,53		16,9
t value T-test		-0,63	
p-value T-test		0,54	

Equal variances are not assumed for this analysis.

The p-value > 0.05 resulted in the test not showing a statistically significant difference between the abdominal perimeters of the two groups (Table 5).

Table 6. Waist perimeter results

	Experimental Group		Control Group
No.	13		12
Mean	96.92		95.7
ST Dev	6.85		16.7
t value T-test		0.24	
p-value T-test		0.812	

Equal variances are not assumed for this analysis.

The p-value > 0.05 resulted in the test not showing a statistically significant difference between the pool perimeters of the two groups (Table 6).

Table 7. Scapulo-humeral symmetry results

	Initial Evaluation		Final Evaluation	
	EG	CG	EG	CG
No.	0.715	0.533	0.583	0.583
Mean	0.524	0.311	0.446	0.359
ST Dev	1.07		-0.28	
t value T-test	p<0.05		0.784	

Equal variances are not assumed for this analysis.

The p-value<0.05 thus resulting in a statistically significant difference (Table 7).

Table 8. Waist symmetry results

	Initial Evaluation		Final Evaluation	
	EG	CG	EG	CG
No.	0.346	0.433	0.246	0.467
Mean	0.506	0.421	0.380	0.464
ST Dev	-0.47		-1.29	
t value T- test	0.643		p<0,05	

Equal variances are not assumed for this analysis.

The p-value<0.05 thus resulting in a statistically significant difference (Table 8).

Table 9. Harvard Test- Summary Report results

	Experiment Group	Control Group
Mean	98.043	99.014
Minimum	81.967	79.787
Median	98.039	99.014
Maximum	114.504	121.951

Equal variances are not assumed for this analysis.

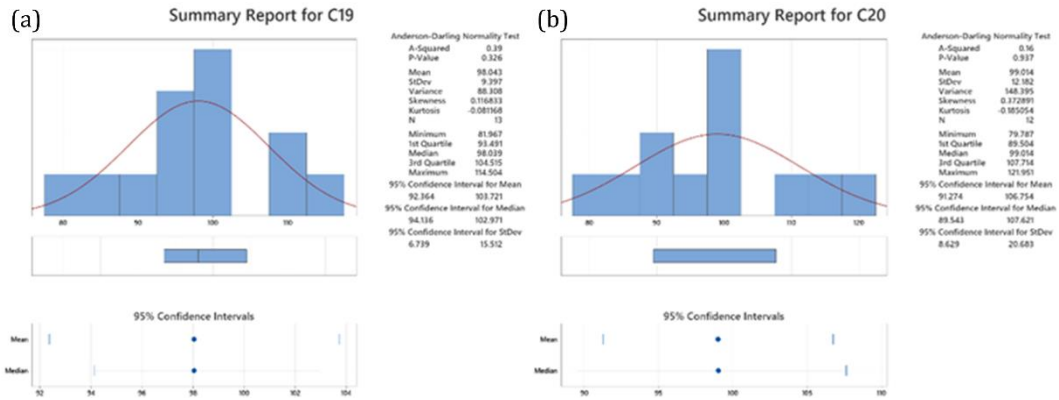

Figure 3. Summary Report results for EG (a) and for CG (b)

Table 10. Harvard Test results

	Experiment Group		Control Group
No.	13		12
Mean	98.04		99.0
ST Dev	9.40		12.2
t value T-test		-0.22	
p-value T-test		p<0.05	

Equal variances are not assumed for this analysis.

The p-value<0.05, thus resulting in a statistically significant difference (Table 10).

Discussion

The final results of the research confirmed the main objective of our study, namely, to achieve wellness by applying for prophylactic or recuperative programs

within an educational institution and increasing the quality of life of the people who have benefited from them.

Achieving the state of wellness by applying prophylactic or remedial programs in an educational institution was the main objective of our study. Using the final results of our research and the feedback provided by the subjects who participated in the study, we can say that we have met the main objective of this work.

As a result of the study we conducted, we found out that the presence of physiotherapists in an educational establishment is essential for the harmonious development of children.

This topic addressed in our study is new, as there are no previous studies to which we can refer in terms of results.

According to the World Health Organization, a child or adolescent should get at least 60 minutes of moderate to vigorous physical activity daily. The results of our study showed that about half of the students who participated in our research use walking as their only physical activity.

The consumption of caffeine-containing beverages (48% of students consume daily and 32% occasionally) and alcohol (8% regularly consume alcohol and 68% occasionally consume) among students is increasing, which is evident from the questionnaire responses in our study. These results should raise some alarm bells among adults, being substances that can bring imbalances in the body: anxiety, depression, fatigue and stress (Rodak & Kratz, 2021).

The correct use of backpacks plays an important role in students' posture. 24% of the students use a bag, and 76% use a backpack. Subjects were asked to show how they position their backpack. All individuals misused it, leading to kyphosis and hyperlordosis, by hanging the backpack because the straps were too wide. Explaining the correct use of such an object, the positive results of proper wearing, and the negative results of incorrect use can prevent postural deviations.

Conclusions

The hypothesis of our study was confirmed; the subjects in the experimental group who followed a personalized rehabilitation program developed by a pediatric physical therapist, which contains specific exercises to correct postural deformities for whole body prophylaxis, obtained significantly better results in terms of posture compared to the subjects in the control group who followed the Physical Education class in the school curriculum.

Following the initial assessment at the beginning of the study, we concluded that students show multiple postural variations that could be prevented in educational establishments in the presence of at least one pediatric physiotherapist.

Explaining the importance of maintaining an appropriate posture and how to prevent it from deviating from normal led to body and postural awareness of each individual. We propose introducing a pediatric physiotherapist to the school's multidisciplinary team to correct and prevent postural deviations. Regular assessment of pupils for postural deviations should be carried out at least twice a year to keep track of the developmental stages of each individual. Another proposal is to repeat the study on a larger scale to validate the results.

Limitations of the study

The first major limitation of the study was that the research sample consisted of only 25 subjects. A second limitation was that the sample size calculation could not be applied due to the small number of subjects, as it was not relevant. Furthermore, the last limitation was the absence of the statistical power calculation, which was not included for the same reasons stated above.

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Comparative analysis of health behaviors among female university students: The impact of sports activity on psychological, physical, and nutritional dimensions

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Abstract: This study conducted a comparative analysis of health behaviors (psychological, physical, and nutritional) related to sports activity among female students at Mohamed Lamine Debaghine University Setif 2, using a descriptive research design, the study included 122 female students from, data were collected using a questionnaire measuring healthy lifestyle behaviors, Statistical analyses were performed using SPSS, including Mann-Whitney U tests to compare practitioners and non-practitioners of physical activity. The results revealed statistically significant differences in physical, psychological, and nutritional patterns related to practicing physical activity. Practitioners consistently demonstrated higher mean ranks across all three dimensions compared to non-practitioners. The psychological dimension showed the most pronounced difference ($U = 918.75$, $Z = 4.452$, $p < 0.001$), followed by the physical ($U = 1167.73$, $Z = 3.129$, $p = 0.002$) and nutritional dimensions ($U = 1165.50$, $Z = 3.243$, $p = 0.001$). These findings highlight the positive impact of regular physical activity on overall health behaviors among female university students. The study recommends implementing comprehensive physical activity programs tailored specifically for female students, integrating sports and exercise into the curriculum and campus life. Additionally, developing targeted interventions to address the psychological dimension is crucial, as it showed the most significant difference between practitioners and non-practitioners. This could include stress management workshops and mental health support services linked to physical activity.

Keywords: healthy lifestyle, physical activity, psychological health, physical health, nutritional health

Introduction

Individuals acquire a specific lifestyle and pattern from childhood within their family, influenced by their growth, culture, and health awareness. This may involve adopting a healthy lifestyle leading to good health or one that threatens it. Abandoning certain habits can become difficult as they become an integral part of an individual's life. For instance, studies have shown that children raised in families prioritizing physical activity and healthy eating are more likely to adopt similar behaviors, significantly enhancing their overall well-being and reducing the risk of chronic diseases later in life (Man et al., 2020).

In recent years, there has been an increased understanding of how these factors affect the health of female students facing challenges in the transition to higher

education. This transition may lead to neglecting health aspects and decreased levels of physical activity due to increased academic demands (Winpenny et al., 2020), making them more susceptible to adopting unhealthy lifestyles (Kotarska et al., 2021) due to changes in their daily routine, dietary habits, and physical activity levels. Moreover, studies have highlighted that female students in higher education often face barriers to engaging in physical activities due to time constraints and academic requirements, negatively affecting their health and mental well-being (Pedersen et al., 2021).

Previous research indicates that high-achieving female students tend to engage in relatively little physical activity due to academic pressures. The lack of participation in sports activities is a concerning indicator for female students, as physical and sports activities are associated with numerous benefits. Research suggests that physical activity is closely linked to subjective well-being, life satisfaction, and enhanced happiness through participation in sports activities (Wypych-Ślusarska et al., 2023). It also alleviates symptoms of depression and ongoing anxiety among female students and improves mood (Yang et al., 2023). In addition to mental health benefits, it works to improve physical health (Mhamed, 2024).

Engagement in regular aerobic activities has been thoroughly evidenced to markedly elevate the overall quality of life among female students. The World Health Organization, in its comprehensive guidelines, advocates for a minimum engagement of 150 minutes of moderate physical activity weekly. This recommendation emphasizes the paramount importance of nurturing both physical and mental well-being, a notion substantiated by a plethora of studies within the domain (Rogowska et al., 2020). Regular participation in physical activity has been consistently linked to enhanced peer relationships and improved academic performance—elements that are particularly critical during the pivotal transition to higher education (Bi et al., 2023). Intriguingly, the degree of physical activity among female students has been positively correlated with their overall sense of self-satisfaction and personal fulfillment. Additionally, various studies suggest a constructive relationship between the extent of physical activity and overall life satisfaction among students. Notably, it has been documented that physically active students report significantly elevated levels of satisfaction, energy, and positive emotional states when juxtaposed with their less active peers (Lu et al., 2022). In spite of this burgeoning corpus of evidence attesting to the irrefutable significance of physical activity in enhancing quality of life, a persistent knowledge gap prevails concerning the comprehensive understanding of health behaviors—spanning psychological, physical, and nutritional dimensions—and their interrelations with sports participation among female students at Algerian universities. This knowledge deficit may obstruct the formulation of effective intervention and support strategies tailored for these students. Therefore, this study aims to systematically compare the levels of health behaviors (psychological, physical, and nutritional) associated with sports activity among female students at the University of Mohamed Lamine Debaghine Setif 2. The primary objective is to elucidate the multifaceted influences of sports participation on the diverse health behaviors of female students, with a particular focus on comprehending the psychological, physical, and nutritional dimensions involved, while thoroughly

investigating various factors that may shape this intricate relationship. Gaining critical insights into this association will facilitate the development of effective programs explicitly aimed at promoting a healthier lifestyle among female students within the university milieu. Ultimately, this endeavor aspires to substantially enhance their overall quality of life and academic achievements. This study has thus generated the following pivotal research inquiries:

- Are there significant differences in physical health behaviors between female university students who regularly engage in sports activities and those who do not?
- Do female university students who participate in regular sports activities exhibit different psychological health behaviors compared to those who do not?
- Is there a significant difference in nutritional health behaviors between female university students who regularly practice sports activities and those who do not?

Materials and methods

Participants

The study sample comprised 122 female student athletes enrolled at the Sports Institute in Setif University for the 2024-2025 academic year. Participants were randomly selected from the female student population. The mean age of the participants was approximately 24 years old (± SD). This sample represents a group of young adult women actively engaged in sports-related studies and activities, providing insights into the health behaviors of female university students with a focus on physical education and sports science (Table 1).

Table 1. Research participants

		N	**Percentage**
Groups	Practitioner	75	61,74%
	Non-practitioner	47	38,52%

Instruments

The questionnaire, a crucial method for collecting research data, was employed in this study to gather information about health awareness related to sports activity among female students. The development of this instrument progressed through several stages to reach its final form. After a comprehensive review of previous studies and analysis of their tools, the researcher prepared a list of health awareness items to construct the questionnaire. The final version includes 42 items distributed across three main dimensions: Psychological Health Awareness, Physical Health Awareness, and Nutritional Health Awareness, with each dimension containing 10 items (items 1-10, 11-20, and 21-30 respectively). To ensure validity, the questionnaire was presented to a group of specialists for review. Based on their feedback, the wording of some items was modified, while the overall structure and main dimensions remained unchanged. This rigorous process resulted in a comprehensive and well-structured instrument designed to effectively measure health awareness related to sports activity among the target population (Table 2).

Table 2. Distribution of questionnaire items across dimensions

Dimension	Items	Number of Items
Physical Health Behavior	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	10
Psychological Health Behavior	11, 12, 13, 14, 15, 16, 17, 18, 19, 20	10
Nutritional Health Behavior	21, 22, 23, 24, 25, 26, 27, 28, 29, 30	10

The questionnaire items were formulated in a closed-ended format with three response options: Always (3), Sometimes (2), and Never (1). The performance score of the respondents is calculated by summing the ratings of the sample's responses to all questionnaire items to obtain the total score for each respondent. The respondent's score ranges from 30 to 90.

Study procedure

The research tool was developed through a comprehensive review of health behavior literature, resulting in a 30-item questionnaire distributed across three dimensions: physical, psychological, and nutritional health behaviors. To ensure content validity, the questionnaire was reviewed by a panel of specialists, leading to modifications in item wording while maintaining the overall structure. A pilot study was conducted with 25 female students to assess completion time and initial reliability. Following validation, the final questionnaire was administered to the main study sample of 122 female students (75 from sports department and 47 from non-sports departments).

Psychometric properties

Validity

To evaluate the instrument's validity, we computed the Pearson Correlation coefficient for many associations, including (item, total scores), (item, dimension), and (dimension, total scores), as presented in Table 3.

Table 3. Correlation coefficients between (item, total scores), (item, dimension), (dimension, total scores) for questionnaire

Physical Health Behavior		Psychological Health Behavior		Nutritional Health Behavior	
Items	R	Items	R	Items	R
01	0,686**	11	0,728**	21	0,382*
02	0,721**	12	0,656**	22	0,539**
03	0,699**	13	0,589**	23	0,676**
04	0,547**	14	0,698**	24	0,697**
05	0,698**	15	0,654**	25	0,412**
06	0,477**	16	0,690**	26	0,366*
07	0,511**	17	0,568**	27	0,541**
08	0,624**	18	0,686**	28	0,454**
09	0,617**	19	0,625**	29	0,775**
10	0,542**	20	0,573**	30	0,659**
Total score	0,901**	Total score	0,889**	Total score	0,923**

The analysis of the health behavior questionnaire reveals strong internal consistency and construct validity across Nutritional, Physical, and Psychological dimensions. Most items correlate well with their respective dimensions ($r > 0.5$), and each dimension strongly correlates with the overall questionnaire ($r > 0.88$). This

indicates that the questionnaire is a reliable and valid tool for assessing health behaviors, with the psychological dimension showing particularly strong correlations, except for item 16 (r = 0.102), which may need further examination.

Reliability

Split-Half Reliability

The scale was split into two halves (the first half of the items versus the second half of the items) after excluding certain statements, and the correlation coefficient between them was calculated. The researcher then used the Guttman equation to adjust the test length, which yielded a value of 0.863, indicating the reliability of the test. The Cronbach's alpha coefficient for the first half of the items was 0.913, and for the second half was 0.878.

Cronbach's Alpha

The reliability of the information processing scale was confirmed using Cronbach's alpha coefficient, which had a value of 0.939, indicating strong reliability of the scale.

Statistical Methods

Statistical analysis was conducted using IBM SPSS Statistics version 24. The Kolmogorov-Smirnov test was applied to evaluate the normality of data distribution. Given the non-normal distribution of the data, non-parametric tests were utilized for subsequent analyses.

To compare health behavior dimensions (physical, psychological, and nutritional) between sports activity practitioners and non-practitioners, the Mann-Whitney U test was employed. This test was selected for its suitability in analyzing non-normally distributed data and comparing two independent groups. The reliability of the health behavior questionnaire was assessed using Cronbach's alpha coefficient for each dimension and the overall scale, while correlation coefficients were calculated to ensure validity.

Results

To determine the differences between the two groups, the results were subjected to the Kolmogorov-Smirnov test for normality of distribution, where we found that Both groups show very low Sig values ($p < 0.05$), suggesting that neither group follows a normal distribution. This supports the decision to use non-parametric tests like the Mann-Whitney U test.

Table 4. Results of Mann-Whitney U Test for physical, psychological, and nutritional dimensions attributed to the practice variable

	Groups	N	Mean rank	U	Z	Sig
Physical	Practitioner	75	69.41	1167.73	3.129	0.002
	Non-practitioner	47	48.87			
Psychological	Practitioner	75	72.75	918.75	4.452	0.000
	Non-practitioner	47	43.55			

Nutritional	Practitioner	75	69.71	1165.50	3.243	0.001
	Non-practitioner	47	48.39			

Table 4 presents the results of Mann-Whitney U tests comparing health behaviors across physical, psychological, and nutritional dimensions between practitioners and non-practitioners of physical activity among female university students. The analysis reveals statistically significant differences between the two groups across all three dimensions. For the physical dimension, practitioners demonstrated a significantly higher mean rank (69.41) compared to non-practitioners (48.87), U = 1167.73, Z = 3.129, p = 0.002. This suggests that students who engage in physical activities tend to exhibit better physical health behaviors. The psychological dimension showed the most pronounced difference, with practitioners having a substantially higher mean rank (72.75) than non-practitioners (43.55), U = 918.75, Z = 4.452, p < 0.001. This indicates that physical activity participation is strongly associated with more positive psychological health behaviors. Similarly, in the nutritional dimension, practitioners displayed a higher mean rank (69.71) compared to non-practitioners (48.39), U = 1165.50, Z = 3.243, p = 0.001. This implies that students who practice physical activities are more likely to adopt healthier nutritional behaviors (Figure 1).

The consistently lower p-values (all p < 0.05) across all dimensions provide strong evidence against the null hypothesis of no difference between the groups. These results support the alternative hypothesis that there is a significant relationship between physical activity practice and health behaviors across physical, psychological, and nutritional domains among female university students. As shown in the following figure.

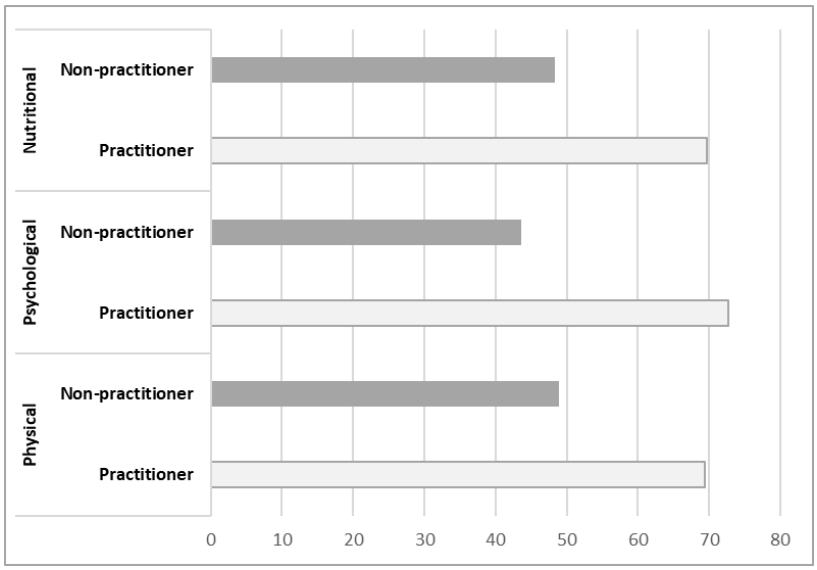

Figure 1. Histogram showed level of physical, psychological, and nutritional dimensions attributed to the practice variable

Discussion

This study aimed to investigate the impact of physical activity on health behaviors among female university students at Mohamed Lamine Debaghine University Setif 2. The research focused on three key dimensions: physical, psychological, and nutritional health behaviors. Using a Mann-Whitney U test, the study compared these behaviors between students who regularly engage in sports activities (practitioners) and those who do not (non-practitioners). The analysis revealed significant differences across all three dimensions, with practitioners consistently demonstrating higher mean ranks compared to non-practitioners. These findings provide valuable insights into the relationship between physical activity and overall health behaviors in the university setting, which will be discussed in detail in the following sections.

Table 3 indicates significant differences in the physical behavior dimension attributable to the variable of sports practice. The researcher attributes these study results to the fact that the majority of female students who practice sports possess a better physical pattern, which may reflect a greater concern for their physical and bodily health through their participation in various activities. These differences perhaps reflect the adoption of a generally healthy lifestyle by the practicing students. Regular physical activity improves physical health by enhancing various health indicators, such as blood pressure and cholesterol levels (Widiastuti et al., 2023). Additionally, exercise contributes to regulating heart rate and cardiorespiratory endurance. A study by Zhang & Min (2022) indicated that physical exercise improves heart and lung function. Sports activities also lead to fitness development and increased effectiveness of vital organs, allowing muscles, nerves, and vital systems to function efficiently. Sultoni et al. (2019) pointed out at the 2019 International Conference that regular physical and sports activities improve aerobic endurance with good oxygen absorption, thereby enhancing blood circulation, metabolism, and various body systems (Robbins & Gerszten, 2023).

The relationship between sports practice and health has never been as strong as it is now. Sports practice is a means for a better healthy life, and health should be a goal maintained by sports practitioners. A study showed that regular exercise improves heart and circulatory functions, reducing the risk of cardiovascular diseases such as atherosclerosis and coronary artery disease (Indrakumar & Silva, 2024). Furthermore, studies indicate a positive relationship between health awareness and physical activity, emphasizing the importance of physical activity in developing a better understanding of body functions and capabilities. In the same context, research results in young athletes found a significant positive relationship between body awareness and physical activity levels, suggesting that increased physical activity enhances individuals' awareness of their bodies (Asan, 2023). Moreover, female students have a better perception of the concept of health, therefore they tend to engage more in physical activities to promote healthy lifestyles (Bademli & Lök, 2018). The educational level of the students has made them realize that practicing various types of physical activities contributes to reducing the risks of chronic diseases such as cardiovascular diseases and diabetes (Oja et al., 2024).

Contrary to our findings, Dorado & Racca (2019) reported no significant link between healthy lifestyle knowledge and actual dietary and physical activity behaviors. This inconsistency may stem from methodological variations between the studies. The results also differ from those of Sadeghi et al. (2023), observed no significant correlation between healthy lifestyle practices and abdominal obesity in male participants. However, for female participants, they noted that each one-point increase in healthy lifestyle score corresponded to a 0.65 cm reduction in waist circumference. Suggesting that gender or hormonal factors may play a role in the relationship between healthy lifestyle and physical pattern.

Table 3 indicates significant differences in the psychological behavior dimension attributable to the variable of sports practice. The researcher attributes these study results to the fact that the majority of female students who practice sports possess a better psychological pattern. These differences are particularly evident in levels of anxiety, depression, and self-esteem. This improved psychological pattern may reflect the impact of physical activity on various psychological aspects. Studies indicate that regular physical activity contributes to improving mood and reducing levels of anxiety and depression (Hoffmann et al., 2022). This is due to the fact that practicing various types of sports activities contributes to the secretion of endorphins, which are responsible for improving the mood of female students. Previous studies suggest that exercising with sufficient intensity and duration increases circulating beta-endorphin levels, enhancing cognitive abilities and mental well-being through multiple mechanisms such as increased cerebral blood flow and mood modification (Pujari, 2024).

Physical activity promotes mental health through neurological and biochemical mechanisms, including increased production of neurotrophic factors and neurotransmitters that improve mood (Strasser & Fuchs, 2015). In the same context, previous studies indicate that regular physical activities, including aerobic exercises, resistance training, and mind-body activities, can enhance sleep quality and address disorders such as insomnia, sleep apnea, and sleep-related movement disorders (Giannaki et al., 2024). Furthermore, engaging in physical activity increases feelings of achievement and self-efficacy, enhancing self-esteem and self-confidence. Research confirms that physically active interventions can lead to improvements in cognitive functions and cognition in general for all age groups (Mazur & Bulski, 2024), reinforcing the idea that physical activity positively contributes to self-efficacy and self-respect. Results showed a strong relationship between high levels of physical activity and improved cognitive function among students (Tarigan et al., 2022), suggesting that regular exercise can alleviate cognitive decline in female students. Moreover, developing social skills through sports participation is particularly beneficial for female students who practice sports. Additionally, adolescents with strong social skills are more likely to engage in health-promoting behaviors such as regular physical activity and healthy eating (Rajkumari et al., 2021), which is essential for building self-esteem. This is due to the various sources of social support that female students receive, whether from family or peers. The results of this study differ from those of Martland et al. (2024) regarding the effects of exercise and physical activity on mental health, depression severity, burnout, traumatic stress, and fatigue. Exercise or physical activity did not appear to reduce anxiety symptoms, which may

be due to the academic pressures surrounding female students. The study conducted by Ahn & Kim (2022) confirms that transitioning to a regular exercise routine for inactive university students can be challenging and may not lead to immediate psychological benefits. This suggests that the relationship between physical activity and psychological well-being is not direct and can be influenced by individual circumstances such as cultural norms of the society.

Table 3 indicates significant differences in the dietary behavior dimension according to the variable of sports practice. The researcher attributes the results of this study to the level of nutrition-related culture among female students who practice sports, with most of them following a dietary program to maintain their health. This is due to the risks associated with modern foods containing chemical substances. Studies have shown that a large number of athletes recognize the importance of nutritional guidance, with many expressing a desire for professional nutritional support to improve their diets and enhance performance (Boumosleh et al., 2021). This reflects that female students have become more aware of the nutritional aspect. The researcher also notes the role of social media and technological advancements in raising the level of nutritional awareness in society, especially among those who exercise regularly. A study by Boidin et al. (2021) showed that nutrition education programs significantly improve dietary intake and knowledge among athletes to maintain health. This is attributed to the educational level of female students, which plays a role in their attitudes towards proper and healthy nutrition. Female students who practice sports are concerned with consuming a balanced, healthy diet due to its effect on the body's organic systems. Nutritional needs for sports are highly sensitive due to physiological changes that occur in female students, such as hormonal fluctuations associated with the menstrual cycle, which affect nutritional requirements (Jiménez-Casquet et al., 2024). A balanced diet in its components helps provide energy to the body for good physical performance (Göbel, 2023), including proteins that play a role in cell regeneration and carbohydrates as essential nutrients that provide energy for our bodies and recovery processes in athletes (Fleming & Al-Zubaidi, 2023).

It is also known that a balanced diet not only nourishes the body but also aids in recovery and injury prevention for female students (Rupasinghe et al., 2023). The social environment surrounding athletes can have a significant impact on their dietary behavior. Female students who practice sports are often in environments that encourage the adoption of healthy habits. Social and cultural factors drive women to closely monitor their health, especially in the context of sports participation (Ramón-Arbués et al., 2021). Results from a study by Lee et al. (2022) indicated strong positive correlations between nutrient-rich food, performance motivation, and mental well-being.

Conclusions

Physical sports activity plays a pivotal role in promoting a healthy lifestyle, significantly impacting an individual's physical, psychological, and nutritional aspects, such as sleep quality, stress levels, dietary patterns, and physical fitness indicators. Considering that a healthy lifestyle and adherence to healthy habits

prevent future health problems, the ultimate goal of engaging in physical activities is to help all members of society reach their optimal physical and health levels. Committing to an athletic life will influence, in one way or another, the determination of a healthy lifestyle from the physical, psychological, and nutritional perspectives for the individual.

Therefore, there is an urgent need to conduct follow-up studies to evaluate the impact of sports activity on healthy lifestyles among female university students, as they represent an important segment of society and are at a critical age for forming sustainable healthy habits. From this standpoint, the current study aims to understand the role that physical sports activity plays in determining the healthy lifestyle of female university students, with the goal of contributing to the development of effective health programs that promote physical activity among them. The current study recommends that universities implement comprehensive physical activity programs tailored specifically for female students, integrating sports and exercise into the curriculum and campus life. It is crucial to develop targeted interventions addressing the psychological dimension, as it showed the most significant difference between practitioners and non-practitioners, including stress management workshops and mental health support services linked to physical activity. Additionally, creating awareness campaigns highlighting the benefits of regular physical activity on nutritional behaviors and overall health for female university students is essential. Establishing partnerships between university sports departments and health professionals can provide holistic support for students' physical, psychological, and nutritional well-being. Finally, conducting longitudinal studies to assess the long-term impact of sustained physical activity on health behaviors and academic performance among female university students is recommended to further understand and improve their overall health and academic success.

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Measuring certain personality traits of physical education teachers and their relationship to occupational stress

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Abstract: This study sought to investigate the correlation between personality factors and occupational stress in physical education instructors. The sample comprised 65 middle school educators in the city of Ouargla, utilising a Personality Traits Questionnaire and an Occupational Stress Scale. The findings revealed that physical education instructors demonstrate elevated levels of personality characteristics, encompassing responsibility, emotional stability, self-control, and social features. Furthermore, their levels of work stress were very low. A notable inverse link was identified between emotional stability and occupational stress, indicating that instructors with more emotional stability encounter less stress levels. Moreover, educators with greater years of expertise indicated markedly reduced stress levels. The study advocates for the creation of programs aimed at improving teachers' emotional resilience and fostering a supportive work environment to mitigate occupational stress. These measures can enhance teachers' general well-being and professional performance.

Keywords: personality traits, occupational stress, years of experience, physical education teacher

Introduction

Every individual has a distinct array of characteristics that delineate their personality and affect their behaviour. These characteristics delineate an individual's personality and elucidate their reactions to diverse circumstances (McCrae & Costa, 1999). A teacher's personality, akin to that of any human, comprises several dimensions and traits that influence their interactions (Roberts et al., 2017). These attributes are essential for enabling educators to navigate the challenges of the teaching profession, foster a constructive learning atmosphere, and inspire students to participate actively in the educational process (Saloviita & Pakarinen, 2021).

Personality qualities are crucial for comprehending an individual's behavioural habits. They signify persistent patterns in human behaviour and assist in recognising individual distinctions among people (John & Srivastava, 1999).

Some jobs necessitate particular personality qualities owing to the inherent work-related stress they entail. Individuals' capacity to manage work stress differs according to their personality types (Judge & Zapata, 2015). Teaching necessitates special traits, as researchers have consistently highlighted the significance of a teacher's personality in their effectiveness (Çetin & Jennings, 2024). Educators are pivotal in influencing future generations, rendering their personal characteristics a critical element in good pedagogy.

Workers in diverse occupations encounter occupational stress, anxiety, and tension (Beehr & Newman, 1978). Educators, specifically, encounter numerous demands associated with students, school officials, coworkers, and the resources accessible inside their organisations (Travers, 2001). These pressures considerably affect their pedagogical efficacy and general job satisfaction (Montgomery & Rupp, 2005).

Occupational stress is characterised as any enduring external or internal stressors that disturb an individual's emotional and physical balance (Lazarus & Folkman, 1984). It transpires when job expectations beyond an individual's capacity to manage, resulting in psychological distress and possible health hazards (Bakker et al., 2014). The prolonged duration of these stressors exacerbates their detrimental impact on mental and physical health (Schaufeli & Taris, 2014).

The phrase "occupational stress" encompasses two dimensions: firstly, external environmental factors that generate discomfort and tension; and secondly, the internal psychological responses of individuals to these stressors (Shirom, 2003). Researchers concur that workplace stress occurs when professional responsibilities surpass an individual's coping capacity, resulting in diminished job performance and well-being (Hakanen et al., 2006).

Occupational stress significantly endangers employees' psychological, bodily, and behavioral well-being (Maslach et al., 2001). Educators with elevated stress levels frequently encounter difficulties with focus, motivation, and professional involvement (Travers & Cooper, 1996). Chronic stress may lead to burnout, emotional fatigue, and diminished job satisfaction, ultimately impacting students' learning experiences (Skaalvik & Skaalvik, 2017b). Nonetheless, individuals differ in their capacity to handle stress, contingent upon their personality characteristics and coping mechanisms (Deary et al., 2003).

Personality qualities significantly influence how individuals cope with work stress (John & Srivastava, 1999). Studies indicate that educators possessing strong emotional stability, resilience, and flexibility are more adept at managing stressful classroom settings (Montgomery & Rupp, 2005).

A physical education and sports instructor must demonstrate attributes including leadership, accountability, emotional resilience, and sociability (Capel & Whitehead, 2013). These traits allow them to interact with pupils efficiently, uphold discipline, and cultivate a constructive learning atmosphere (Fletcher & Sarkar, 2013). Moreover, robust personal attributes enable educators to manage the difficulties inherent in their job, such as student conduct, administrative demands, and resource constraints (Burić & Moè, 2020).

Educators exhibiting these personality traits are more inclined to adeptly manage work stress (Çetin & Jennings, 2024). They are more adept at managing pressure from students, colleagues, and the school administration, so assuring the fulfilment of their obligations with assurance and efficacy (Skaalvik & Skaalvik, 2017a).

Numerous recent research have investigated the correlation between personality factors and occupational stress among teachers, emphasising the significant impact of individual differences in addressing job-related issues. Bakker et

al. (2007) investigated the impact of personality traits on burnout and job engagement in educators, revealing that teachers exhibiting high conscientiousness and emotional stability encountered reduced stress levels and exhibited enhanced resilience. Montgomery and Rupp (2005) examined the influence of stress management strategies on teachers with varying personality profiles, demonstrating that those with high openness to experience were more inclined to employ adaptive coping mechanisms, thus mitigating the adverse effects of stress. Moreover, Çetin and Jennings (2024) investigated the impact of self-efficacy and personality traits on teachers' occupational well-being, determining that personality qualities substantially affect teachers' capacity to manage stress and sustain job satisfaction. These studies highlight the significance of comprehending personality traits in the teaching profession, as educators possessing particular characteristics, such as emotional stability and adaptability, are more adept at managing occupational stress and maintaining elevated levels of professional performance (Schaufeli & Taris, 2014).

This study seeks to investigate the correlation between personality factors and occupational stress in physical education instructors. Considering the rigorous demands of the teaching profession, especially in physical education, it is crucial to comprehend how individual personality traits affect stress management and job performance. The research aims to discover essential personality features that enhance teachers' capacity to manage occupational stress, adapt to obstacles, and uphold high professional standards. This research aims to offer significant insights for educators, administrators, and policymakers by analysing these linkages, so facilitating the development of focused measures that promote teachers' well-being and improve their efficacy in the classroom. Furthermore, the results may enhance the field of educational psychology by providing empirical information regarding the relationship between personality and occupational stress in educational settings.

Materials and methods

The Sample

The study sample comprised physical education and sports instructors at middle schools located in the city of Ouargla. The total number of participants was 65 teachers, constituting 65.00% of the study population. The participants were chosen by a basic random selection technique. The study sample distribution indicated that 32 teachers possessed fewer than 5 years of experience, whereas 22 teachers had between 6 and 10 years of experience.

Research Tools

The research employed the Personality Traits Questionnaire, adapted from the instrument utilised by Ghanam (2025), in her work "Personality Traits and Organisational Loyalty among Primary School Teachers." This questionnaire comprises 37 items categorised into four dimensions, offering five response options: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. Each comment received a score from 5 to 1, correspondingly. The smallest score on the scale is 37, and the maximum is 185, indicating the degree to which a teacher exhibits personality

traits. The questionnaire comprises four primary dimensions: Responsibility (9 items), Emotional Stability (9 items), Control (10 items), and Social Traits (9 items).

The research utilised the Occupational Stress Scale for Physical Education Teachers, created by Alaoui (1998). This measure comprises 36 items categorised into six factors: student-related stressors, material resources in the school, monthly salary, relationship with school administration, educational supervision, and relationship with other instructors. Each item offers five response alternatives, ranging from "Applies to me to a very great extent" to "Applies to me to a very small extent." Scores vary from 5 to 1 for good items, whereas negative items are scored inversely. The total possible score varies from 36 to 180, with elevated values signifying increased levels of occupational stress.

Psychometric Characteristics of the Research Instruments

The Personality Traits Questionnaire and the Occupational Stress Scale were administered in their preliminary forms to a pilot sample of 15 physical education teachers to evaluate the validity and reliability of the study items.

Discriminatory validity was assessed by the extreme group comparison approach. The findings indicated that the T-value for the Personality Traits Questionnaire was 4.50, which is statistically significant at the 0.05 level, so affirming the instrument's discriminatory validity. The T-value for the Occupational Stress Scale was 5.51, which was statistically significant at the 0.05 level, demonstrating robust discriminant validity for this scale.

Internal consistency was assessed for reliability using Cronbach's Alpha coefficient. The findings indicated that the reliability coefficient for the Personality Traits Questionnaire was 0.93, whilst the Occupational Stress Scale exhibited a reliability coefficient of 0.75. These scores signify that both instruments exhibit excellent validity and reliability, rendering them suitable for application in the study.

Statistical Examination

Various statistical approaches were applied to analyse the acquired data, ensuring precision and dependability in the interpretation of results. The arithmetic mean and standard deviation were employed to characterise the distribution of responses. T-tests were performed, comprising a single-sample T-test to compare the sample mean against a known value and a two-independent-samples T-test to assess differences between groups. Additionally, one-way analysis of variance (ANOVA) was utilised to evaluate differences among several groups. These strategies facilitated the identification of substantial distinctions and trends within the data, enhancing the overall comprehension of the study's conclusions.

Results

The findings in Table 1 demonstrate that the sample mean for the whole scale exceeds the theoretical mean. The computed T-value (20.68) is significant at 0.05, indicating a statistically significant difference favouring the sample mean. This indicates that physical education instructors exhibit a significant degree of personality traits.

Table 1. Presents the values of the hypothetical mean, sample mean, calculated T-value, and statistical significance level for different personality traits

Variable	Hypothetical mean	Sample mean	T-Value	Significance level	Decision
Responsibility Trait	3.00	4.16	19.81	0.000	Significant
Emotional Stability Trait	3.00	3.84	12.69	0.000	Significant
Control Trait	3.00	3.92	15.12	0.000	Significant
Social Trait	3.00	3.96	15.69	0.000	Significant
Overall Score	3.00	3.97	20.68	0.000	Significant

Furthermore, the results indicate that the sample mean across all personality characteristics (responsibility, emotional stability, control, and social traits) exceeds the theoretical mean. The T-values (19.81, 15.69, 15.12, and 12.69) are all statistically significant at 0.05, hence reinforcing the existence of significant differences favouring the sample mean.

The results indicate that physical education teachers demonstrate a significant level of personality traits across all domains. The participants' responses to the personality traits scale reveal a significant prevalence of these traits, accompanied by an overall sense of contentment and acceptance with their personality attributes.

Table 2. Presents the comparison between the hypothetical mean and the sample mean for occupational stress levels among physical education teachers

Variable	Hypothetical Mean	Sample Mean	T-Value	Significance Level	Decision
OccupationalStress Scale	3.00	2.82	2.89	0.005	Significant

The findings in Table 2 demonstrate that the sample mean (2.82) is inferior to the theoretical mean (3.00). The T-value (2.89) is significant at 0.05, indicating a statistically significant difference in favour of the hypothetical mean. This research indicates that physical education teachers encounter comparatively low levels of occupational stress. The unexpectedly low stress levels indicate that participants view their professional obstacles as manageable, enhancing their overall workplace well-being.

Table 3. Significance of differences in the degree of personal traits availability among physical education and sports teachers attributed to the variable of years of experience

Experience	Sample size	Mean	Standard Deviation	Degrees of freedom	F Value	Significance level
Less than 5 years	32	3.98	0.39	2	0.07	0.92(Not significant)
6 - 10 years	22	3.97	0.36			
11 years and above	11	3.93	0.38			

Table 3 indicates that the F-value attained (0.07) with a significance level of (0.92), which is not statistically significant at the 0.05 threshold. Consequently, there are no substantial differences in the availability of personal qualities among physical education and sports teachers as related to the variable of years of experience. This is evident in the proximity of the means, with a mean score of 3.98 for teachers with less than 5 years of experience, 3.97 for those with 6 to 10 years, and 3.93 for those with 11 years or more of experience. This suggests that years of teaching experience do not significantly influence the presence of personal attributes in the teaching profession.

Table 4. Presents the analysis of variance (ANOVA) results examining the differences in occupational stress levels among physical education teachers based on their years of teaching experience

Experience Level	Sample size	Mean	Standard Deviation	Degrees of freedom	F-Value	Significance level	Decision
Less than 5 years	32	2.93	0.48	2	3.84	0.02	Significant
6 - 10 years	22	2.82	0.47				
More than 11 years	11	2.46	0.46				

The findings in Table 4 demonstrate that the F-value (3.84) at a significance level of 0.02 is statistically significant at 0.05, indicating notable differences in occupational stress levels among physical education teachers according to years of experience.

The disparities in average values further corroborate this conclusion:

- Teachers with fewer than five years of experience exhibited the highest stress levels (M = 2.93).
- Teachers with 6 to 10 years of experience exhibited a marginally reduced stress level (M = 2.82).
- Teachers possessing over 11 years of experience exhibited the lowest stress level (M = 2.46).

The findings indicate that years of experience considerably influence occupational stress levels among physical education teachers, with more seasoned educators reporting markedly lower stress levels than their less experienced counterparts.

Table 5. Presents the Pearson correlation results between the personality traits of physical education teachers and their occupational stress levels

Personality trait	Occupational stress list	Pearson Correlation Coefficient	Significance level
Responsibility Trait		0.08	0.51
Emotional Stability Trait		-0.28*	0.02
Control Trait		0.12	0.32
Social Trait		0.02	0.82
Overall Tool		-0.02	0.86

The findings in Table 5 reveal an absence of a significant association between general personality qualities and occupational stress levels among physical education teachers at the 0.05 significance level, as evidenced by a Pearson correlation coefficient of -0.02, which lacks statistical significance. The Emotional Stability Trait exhibits a statistically significant negative link with occupational stress at the 0.05 level, indicated by a Pearson correlation coefficient of -0.28 ($p = 0.02$).

This indicates that emotional stability is negatively correlated with occupational stress, implying that teachers with more emotional stability generally encounter reduced stress levels. Conversely, other personality traits and the whole personality profile exhibit no significant correlations with occupational stress levels in physical education teachers.

Discussion

This study's findings offer significant insights into the correlation between personality factors and occupational stress in physical education teachers. The

findings demonstrate that physical education instructors possess elevated personality traits such as responsibility, emotional stability, self-control, and social characteristics. These results correspond with earlier studies highlighting the significance of personality factors in occupational performance and stress regulation (McCrae & Costa, 1999; John & Srivastava, 1999).

A principal conclusion indicates that emotional stability has a substantial negative link with occupational stress, implying that instructors with greater emotional stability generally encounter reduced levels of job-related stress. This corroborates the findings of Montgomery and Rupp (2005), who determined that educators possessing strong emotional stability and resilience are more adept at managing classroom issues. Bakker et al. (2007) also emphasised that emotional stability correlates with reduced burnout rates and increased job engagement, underscoring the significance of this feature in mitigating occupational stress.

The findings demonstrate that years of experience are essential in influencing stress levels, since more seasoned educators report markedly lower stress levels compared to their less experienced peers. This outcome aligns with prior research (Hakanen et al., 2006; Çetin & Jennings, 2024), indicating that accumulating experience improves teachers' capacity to manage professional issues. Veteran educators are inclined to have cultivated efficient coping mechanisms over time, hence diminishing their vulnerability to professional stress (Shirom, 2003).

Unexpectedly, other personality traits such as responsibility, control, and social characteristics did not exhibit significant associations with occupational stress levels. This contrasts other studies (Judge & Zapata, 2015; Burić & Moè, 2020), which indicate that conscientiousness and social adaptation enhance stress management. A potential reason for this gap is that physical education teachers may depend more on emotional resilience than on organisational skills or social contacts to cope with occupational stress.

Moreover, the unexpectedly low levels of occupational stress identified within the sample indicate that physical education teachers regard their professional obstacles as manageable. This may be ascribed to the characteristics of their profession, which entails physical exertion and dynamic interactions, potentially functioning as stress alleviators (Capel & Whitehead, 2013; Fletcher & Sarkar, 2013). These findings correspond with Schaufeli and Taris (2014), who contend that job demands surpassing coping capacities result in stress, although good coping strategies can alleviate its adverse impacts.

A significant factor is the importance of workplace conditions, as emphasised in prior study. Elements include interactions with administrators, resource accessibility, and institutional backing significantly influence occupational stress levels (Beehr & Newman, 1978; Travers, 2001; Montgomery & Rupp, 2005). This study primarily examined personality qualities; however, future research could investigate the interplay between individual characteristics and contextual factors in influencing stress experiences.

These findings underscore the necessity of cultivating emotional stability in physical education teachers to mitigate stress and improve job satisfaction.

Educational policymakers and school administrators should contemplate integrating professional development programs designed to enhance teachers'

emotional resilience and stress management methods. Moreover, mentorship programs that connect novice teachers with experienced professionals may assist new educators in cultivating good coping strategies early in their careers.

Notwithstanding the significant findings, this study possesses numerous limitations that warrant acknowledgement. The sample size was modest (65 participants), constraining the generalisability of the findings to a wider group of physical education instructors. Subsequent research ought to incorporate larger and more heterogeneous samples to improve the validity of the results (Çetin & Jennings, 2024). Secondly, the study depended on self-reported measures, which may introduce response bias, since participants could have offered socially desirable answers instead of truthful representations of their experiences (Shirom, 2003). Utilising supplementary data gathering techniques, such as interviews or observational studies, may yield a more thorough evaluation of personality traits and occupational stress (John & Srivastava, 1999). Third, the study was done in a specific geographical region (Ouargla), potentially constraining the generalisability of the findings to different educational situations. Subsequent research ought to investigate cross-cultural comparisons to ascertain the existence of analogous trends across diverse educational environments (Burić & Moè, 2020).

This study exclusively examined personality traits and occupational stress, excluding potential moderating factors such as organisational climate, leadership styles, and individual coping mechanisms (Fletcher & Sarkar, 2013). Examining these supplementary variables may yield a more comprehensive insight into how physical education instructors cope with stress and sustain well-being in their career.

Conclusions

This study enhances the existing literature on personality traits and occupational stress by emphasising the significant influence of emotional stability on stress management in physical education teachers. The results indicate that although personality factors are significant, years of experience considerably affect occupational stress levels, with more seasoned teachers exhibiting reduced stress levels. Future research may investigate the interplay between external factors, such as the school environment and administrative assistance, and personality traits in relation to occupational stress. By executing focused interventions that bolster emotional resilience, educational institutions can assist instructors in managing stress more efficiently, resulting in enhanced well-being and professional success.

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The role of sports marketing in achieving social integration

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Abstract: This research aims to highlight the role of sports marketing in achieving social integration. The results obtained showed that there is an implicit relationship between sports marketing and achieving social integration, as sports marketing contributes to paying attention to the dimensions of social integration by adopting the social concept of sports marketing through the sports marketing mix. The results of the research also confirmed that the contribution of the sports product to achieving social integration is through the provision of goods, services and ideas that include a set of characteristics to satisfy the needs and desires of individuals, the most important of which are the needs of acceptance and belonging. While the Sports price contribution is shown by the perceived benefits that must be higher than the material or intangible cost paid for the success of the desired adjustment process in social behavior. It also highlights the role of sports promotion and distribution through cognitive and educational messages And decisions regarding appropriate distribution outlets.

Keywords: sports marketing, social integration, sports product, sports price, sports distribution, sports promotion

Introduction

Sports are no longer confined to the concept of recreation and sports activation in a competitive format, but rather aim at other dimensions related to the economic and social system prevailing in the country. Although sports enthusiasts can afford to practice an individual sport, sports activities at the local and international levels require a lot of organisation at all levels, whether at the social, economic, administrative and marketing levels. Thus came the idea of including marketing thought in the sports field.

Because the response of individuals is according to the adaptation of the classical hierarchy of effects model in the form of three types of responses (educational response, behavioral response and post-behavioral response), the effect of marketing on the response of individuals and then the behavioral process can be known (Lahouel, 2023).

The marketing concept of sports activities is a relatively new field at the local level and does not have an independent definition, but falls within the general definition of marketing with all its meanings and connotations. In recent years, sports marketing has been witnessing steady growth and is commensurate with the efforts of producing companies to expand their markets in light of the global free market. The latter now allocates a good share of its general budget to sports marketing (Bruhn & Rohlmann, 2022). Contemporary companies also seek to search for everything new and innovative and try to provide it to retain their customers, search for new customers, compete with similar institutions, and be able to grow and survive in a competitive market (Aissaoui et al, 2024), Therefore, the lack of a clear picture of the competitive landscape leads to marketing decisions that are far from confronting the risks that threaten the prospects of the market economy (Ghadjati et al, 2024).

Sports marketing also receives great attention from the people who are working to host various competitions and tournaments, thus creating marketing activities represented in the sale of broadcasting rights, for example, advertising and sponsorship, under the supervision of a marketing body with the aim of achieving material gains. Thus, an important financial resource is formed, both for sports clubs and for organizing and governing bodies.

On the other hand, studies confirm the role that sport plays in integrating into a single social fabric and transcending everything that can be a factor in self-isolation and isolation (Young, 2019). It can also be one of the solutions to the problems caused by urban violence. However, in all cases, sport as a function within an institutional framework is linked to a number of factors that must be present in the social framework concerned in order to have an effective impact on the values and general culture of their societies.

Many sports bodies are unable to implement their annual plans, including their social role, due to lack of interest in the marketing aspect and neglect of sports marketing as an activity and a tool to achieve their economic and social goals. Through the previous proposal, the problem of research can be presented in the next question: How can sports marketing contribute to achieving social integration? The relationship between sports and marketing dates back to 1870 when a tobacco company in the United States printed cards for the most famous baseball players, and inserted them into cigarette packs in order to promote cigarettes (McQuistan & Squier, 2019). Cigarette sales soared, and then these cards were attached to the then popular Bubble gum. These cards marked the beginning of sports promotion for the benefit of the industry.

The methods of advertising and promotion have evolved until the concept of sports marketing has expanded, especially after sports became an economic process and the growth in the field of sports marketing became large and at an amazing speed, which led to an increase in its spread and made commercial companies compete around sponsoring sports events (Bruhn & Rohlmann, 2024). By sponsoring global events such as the World Cup, these companies made fantastic profits, especially when satellite channels entered as an important party in the sponsorship issue because of the companies' desire to advertise their products, because the large numbers of viewers of sporting events became attractive and attractive. Common interests were integrated and a strong relationship was established between commercial companies

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specializing in sports marketing and satellite channels around the world (Al-Satari, 2014). On the other hand, the lack of investment in sports infrastructure, poor funding for sports, and poor training in management and marketing methods may undermine the future of sports in general (Merka & Cojocaru, 2024).

The term sports marketing was first used in the USA before the advertising era in 1989. It has since been used to describe a variety of activities associated with sports promotion (Shilbury, 2009). Accordingly, marketing is one of the main and important functions of any organization, whether in the sports or non-sports field, where the use and application of marketing concepts in the sports field is one of the modern topics addressed by researchers, so there are several definitions of sports marketing, it has been defined by Pits and Stotlar as "the process of designing and implementing activities for the production, pricing, promotion and distribution of sports products or services to satisfy the needs of consumers or participants to achieve the objectives of the body or facility (Darwish et al., 2013).

Grant and Bashom also defined it as "a survey of opinion and trends in the market, and then directing sports products and services to conform to those trends" (Hamdi Ahmed, 2011). Sports marketing is also defined as "a set of integrated and interactive activities in the fields of physical education and sports, linked to the process of creating, pricing, promoting and distributing goods, services and ideas, in order to serve the needs of beneficiaries and achieve the objectives of various sports institutions and workers in the fields of physical education and sports" (Shafei, 2006, p. 86).

In the same vein, sports marketing is defined as "a survey of opinion and trends prevailing in the market, and the orientation of sports products and services (such as tournaments, matches, sports channels, logos) to align with those trends" (Ramadi, 2012, p. 6). According to Mullin et al, sports marketing is defined as the set of activities designed to meet the needs and desires of the sports audience through the exchange process, as sports marketing has developed two main axes: Marketing sports products and services directly to the sports public; Marketing consumer and industrial products and services using promotion during the provision of sports services (Al-Hallaq, 2019).

This definition is consistent with the view of the classical school based on exchange, in which marketing is defined as a socio-administrative process in which individuals and groups obtain their needs and desires by creating and exchanging products and value with others .

It follows from the above that sports marketing is a relatively new field, and does not have an independent definition, but falls within the general definition of marketing with all its meanings and connotations (Cornwell, 2022). Due to the growth of sports marketing in recent years in a steady and proportionate manner, in addition to the attempt of producing companies to expand their markets in light of the global market, it is considered one of the most important foundations for achieving the objectives of the sports organization and includes identifying the needs and desires of the target market, in addition to obtaining the desired satisfaction more effectively and efficiently than competitors.

Sports marketing is defined by four main factors that shape its concept. Firstly, market focus plays a vital role in identifying market characteristics to better meet consumer needs. Secondly, orientation towards the recipient forms the cornerstone of successful sports marketing. This approach involves investing in understanding the needs and desires of recipients. For instance, a study by the German football team Werder Bremen revealed that adding five extra minutes to the halftime break not only enhanced audience satisfaction but also generated annual revenue of €300,000 for the club through increased sales in its affiliated stores. Thirdly, coordinated marketing emphasises the integration of marketing efforts across all organisational departments, requiring strong support from senior management to ensure success. This approach includes inbound marketing, where employees are rewarded, trained, and motivated to work collaboratively to serve recipients. Finally, profitability is a critical factor in sports marketing, as organisations must strive to meet the needs of recipients more effectively than competitors. This focus helps retain existing customers and attract new ones. A prime example is the sports merchandise market, where Bayern Munich generates €17 million annually from shirt sales, followed by Juventus with €13.5 million and Real Madrid with €12 million (Abdeen Muhammad, 2012).

Sports as a product possess unique characteristics that set it apart from other goods and services (Badawi, 2001). Sport is a stand-alone phenomenon, making it difficult for sports marketing to predict people's impressions of matches or the outcomes of games. Fans' emotional attachment to the teams they support adds another layer of complexity to the marketing process (Ladhari et al., 2022). These factors create a distinct and challenging environment for promoting sports products and services.

Additionally, several considerations must be made when marketing in the sports field. The final product is intangible, as the focus is not on the primary product itself but on the continuity of providing the service (Günay & Ijjaali, 2023). Consumer satisfaction is often linked to external factors such as the surrounding climate or social framework. Sports services are directly purchased by end consumers, and their significant presence in the media underscores their societal importance. However, the reliance on government subsidies for sports spending has historically limited the demand for extensive marketing efforts. Furthermore, sports marketers face challenges such as the inability to control the nature of the product, the absence of physical distribution activities, and the non-storable nature of sports products (Badawi, 2001).

In response to criticisms of traditional marketing, a new perspective has been developed that seeks to balance three core interests. This perspective emphasizes the consumer's right to access safe, high-quality, and affordable goods, the manufacturing enterprise's need to achieve appropriate returns on investments while managing risks, and society's broader interest in safeguarding the environment and public health. This evolving approach provides a foundation for aligning marketing strategies with contemporary societal and consumer expectations.

In response to the numerous criticisms directed at traditional marketing practices, a new perspective has emerged, emphasising a balanced and holistic approach. This perspective prioritizes the consumer's interest in accessing high-

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quality, safe, and affordable goods while addressing the needs of manufacturing enterprises by ensuring appropriate returns on their investments in exchange for the risks they undertake. Additionally, it integrates the broader societal interest, emphasizing the importance of minimizing harm to the environment and safeguarding public health. This shift reflects a growing recognition of the need for marketing strategies that align with ethical, economic, and environmental responsibilities.

This trend has been called the social concept of marketing, which has expanded the functions and scope of application of marketing.

Therefore, to the extent that the application of sports marketing is beneficial to organisations and societies in general, it benefits sports organisations and increases their profits at the same time. Thus, it should be noted that some sports organisations are targeted for declaring their commitment to contribute to social development in general and social integration in particular, to improve their mental image in society and push them to overlook the damage that sports organisations can cause to the environment or abnormal dealings, etc.

Sports marketing does not differ from marketing in general in terms of the use of elements of the marketing mix, as it works to satisfy the needs and desires of the sports consumer and achieve the goals of the sports organization. This is done by providing the product or service and displaying it in appropriate places and at reasonable prices, while developing an effective promotional program.

It should be noted that sports marketing does not seek to achieve the objectives of the sports organization only, but also aims to achieve the welfare and happiness of society through the responsibility entrusted to it, which starts from paying attention to the problems of society to reducing their effects, especially with regard to social deviation, social adaptation, social normalization, social status, social class and social mobility, differentiation and minorities, hooliganism and violence.

Accordingly, the social concept of sports marketing is characterized by some characteristics that the marketing officer must take into account to achieve the effectiveness of the marketing mix and the effectiveness of each of its elements in achieving this concept, especially social integration.

Materials and methods

A sports organization can achieve social integration by applying the social concept of sports marketing through a sports marketing mix that consists of four basic elements: sports product; sports pricing; sports promotion; and sports distribution. The sports product is one of the most important components of the marketing mix and is the good or service produced by the organization to meet the needs and desires of sports consumers. A product is defined as "a set of characteristics that satisfy the needs and obtained by the consumer through the process of exchange and that includes a set of material and psychological benefits" (Abdullah, 2013).

The mathematical product is defined as "every material commodity made, anything that can be touched or seen (Smith, 2008). Thus, the word product is used in sports marketing in different directions including physical goods, services, ideas, and even the combination between them. The concept of a sports product includes

four types (material goods, services, ideas, or a combination between them), which includes a set of characteristics to satisfy the needs and desires of the consumer. One of the most important needs of the individual is acceptance, as the bulk of the human personality is based on the sociocultural organisation within which the individual exists. The individual, therefore, wishes to always be accepted by others, especially in childhood. The group's attitude towards him and its association with him are considered organized forces for his personality, whether by acceptance or rejection.

The human concept of himself also plays an influential role in reducing the self-contradiction (between the individual and himself). This reinforces the individual's expectations of acceptable behaviour that is supposed to emanate from him during his interaction with the group. Thus, an individual's acceptance of himself is linked to his acceptance within the group or team. This means that acceptance as a social need is related to the nature of social situations and the cultural framework experienced by the individual. Therefore, the creation of a valid and appropriate group, such as a play group or a sports team, allows the individual to form important and appropriate concepts to shape the child's personality, such as the individual's image of his body and the image of the individual about his movement. This is in contrast to unfit groups such as gangs and deviant individuals, which only reinforce deviant behaviour patterns.

Affiliation is also one of the needs that the individual seeks to satisfy, as the individual's belonging to the group is achieved through satisfying their needs through the community, the willingness to play a role as a member of the community, and the confidence of the individual in the participation of his concepts with the concepts of the group (Al-Khouli, 1996).

Results and discussions

As a result of an individual's belonging to the sports team, as a small, coordinated, interconnected and well-founded group, what the individual wishes to do will become the same as what he perceives, as a requirement resulting from his social role. If he goes out of the field to the reality of life and society, as a general frame of reference, his belonging to this reality depends on his belief that he has a role in the real world.

Social integration can be achieved through the following divisions of the mathematical product: Sports goods, Sports services, Composition (goods, services and ideas) (Smith, 2008).

Sports goods It is the sum of tangible material goods that fall within the framework of the sports industry. Examples of physical goods for sports include: sports shoes, tennis rackets, golf balls... Etc. On the other hand, there is a type of physical goods that are not used exclusively for sports, in the sense that they are used in sports or in sports experiments, such as sunglasses, hats, shirts, watches, solar powders, where these products can be tested or tried with the senses such as touch, taste, smell and hearing due to their tangible physical nature.

Sports services are intangible products, where institutions providing sports services provide benefits or benefits in the form of intangible experiences, for example, services provided in the form of recreational and fitness opportunities, or through television interviews, physiotherapy, training, and others. As these services

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are intangible and cannot be bought and taken away, it is not possible for sports bodies to create long-term stored services for current or prospective consumers. Thus, there are four important differences between physical goods and services that have a deep resonance for sports marketing: tangible, consistency, wear and divergence.

An individual may buy sports equipment with the idea of becoming more agile or having stronger muscles. In another example, the idea of a sports product can be reflected in the realisation of the power of sport, the realisation of a sense of identity and the provision of an alternative for the masses. Through the above, it can be said that sport affects the consumer with psychological reactions, so he believes in several things as a response to thinking, as sports events cannot be limited to goods and services provided to the consumer only, but can be those ideas that are sold to the consumer that are associated with belonging and success.

Composition (goods, services and ideas), The majority of sports products are composite products from a group of tangible and intangible elements, where there are many physical goods that have service characteristics or elements associated with related ideas. Goods are often bought by the sports consumer because of the intangible property of their benefits, unlike other services that are related to something tangible material, membership in a football club may be concluded with a deal that includes club posters, badges and regular newsletters. The sports consumer often uses compound benefits for goods, services and ideas, as there are many examples of sports services that have been converted into sports goods, such as live games that have been converted into DVDs. Therefore, the installation and coordination of goods and services in sports marketing is usually carried out.

Price is one of the most important elements of the sports marketing mix, as it directly affects the revenues of sports clubs, as the sports products and services provided by clubs need inputs for the survival and continuation of this interaction. Price is also the most flexible element of the sports marketing mix because it is easy to change.

From a marketing perspective, price is one of the main determinants of value that is at the heart of sports marketing. Price is defined as the art of translating a product's value at some point into cash. The process of developing a pricing strategy is of great importance because it expresses the success of the marketing plan (Bernstein, 2015). Just as price represents tangible things such as money and time, it also represents imperceptible things such as change in beliefs and habits (Alnajem, 2016). The benefits or benefits perceived by the target parties may be much higher than the material or moral cost paid for the success of the desired modification process in the desired social behaviour, such as social deviation, where individuals differ in their ability to integrate socially, so some arise socially and others are antisocial. The antisocial individual expresses a socially abnormal phenomenon. It is from this category that delinquency, criminality and events appear. They are considered to be individuals who have not been socialised in an appropriate way in challenging the prevailing values and legal structure in society.

Alderman explained the close relationship between the individual's ability to integrate socially and the extent to which his need to belong is satisfied through

sports, as the social individual, that is, the socially integrated is often athletic and distinguished by vitality, activity, and mental and emotional presence, unlike what is characteristic of most introverts (Alderman, 1974).

When estimating the price of a sports product associated with social integration, some factors must be taken into account, including the price level of this product, is it high or low? Because the low price or free product may lead to negative perceptions about the product.

There are a set of controls to be considered when carrying out the mathematical pricing process taking into account the appropriateness of the price of the sports service for the sports beneficiary; considering the price of the sports service reflecting the true level of the sports service; ensuring the continuity of the sports service through the appropriate price of the sports service; conducting pricing studies with centers specializing in marketing; pricing bases must be in the light of market conditions; prices must be commensurate with the income of most strata of society; the price paid by the beneficiary is always very small compared to the total cost; and determining prices through what the beneficiary will bear instead of full cost recovery (Shafei, 2006).

Sports promotion is defined as "the ability of a sports marketer to communicate with customers, to inform, persuade and remind them about the advantages and benefits of sports products and services" (Smith, 2008). From this definition, it is concluded that sports promotion works in three directions, namely: Information giving information and building awareness that a sports product or service exists, what is offered and where it can be obtained; Persuasion building positive attitudes towards a sports product or service and motivating it; Reinforcement: that is, dispelling doubts about the action you are doing (buying or using) and ensuring that there is a suitable climate for future buyback. (Darwish et al., 2013) .

The sports sponsorship strategy also falls under the general sports promotion strategy, as it can be considered a public relations strategy or a sales promotion method (Harakti et al., 2021).

Therefore, sports promotion that contributes to social integration relies more on cognitive and educational messages that seek to convey an idea that leads to behaviour change and stabilises this change, such as social adaptation. Sports promotion may use personal and impersonal methods, such as media and new technology, to tell target individuals about the benefits of sports programs and convince them to exercise for social adaptation.

If social adaptation expresses compliance, many studies have addressed and emphasized the nature of the relationship between social adaptation and physical implications such as physical characteristics (such as short stature, weight), physical activity, etc. Based on the results of studies such as Hardy, Sanford, Tyron and others, which collectively indicate that individuals practising sports are distinguished by being integrated into social activity and are more socially acceptable. Thus, sports promotion is one of the most dangerous and influential elements on the success or failure of sports marketing campaigns or plans, because it is the mirror through which marketing activities are reflected.

It should be noted that the promotional mix used to contribute to social integration does not mean that it will be suitable for use in another social, economic

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or political circumstance. The nature of the sports product to be marketed, as well as the demographic and psychological characteristics of the target parties, determine the nature of the promotional mix. However, the complementarity and harmony between the elements of sports promotion (advertising, public relations, personal selling, sales promotion) can contribute to creating a positive and supportive impact on each other in stimulating social inclusion.

Because the essence of sport is fair competition based on fair principles in arbitration, it is one of the important means of normalization of social conflict and the concept of competition. Thus, each individual is aware of the components of the social system in which he lives in terms of roles, positions and social status.

On the other hand, several points must be taken into account when carrying out the promotional process, the most important of which are: coordination of elements of the promotional mix; allocation of a promotional budget; the use of specialized agents or offices to carry out promotional campaigns for tournaments and matches through the most widespread media; focusing on the benefits that will accrue to the beneficiaries of the service; and determining the appropriate promotional tool based on the nature of the target market and the beneficiary, and the results of the research (Shafei, 2006).

From the above, promotion can be considered as the vital link between the sports organisation and its audience. By using techniques to connect with consumers, attract their attention to what they market and increase their loyalty, a player who acquires acceptable attitudes towards his team or club, such as pride and loyalty, will improve his status by improving his social role. This pushes his fellow players to take on similar roles, which enhances cohesion and team unity. But the biggest role in providing this healthy social climate depends on the educator and sports leader. Thus, the process of loyalty from the club to the village and the city or region to which it belongs until it reaches loyalty to its homeland and belonging to it.

Sports distribution is defined as the various activities carried out by an organization to make a sports product or service readily available to customers (sports audiences, sports clubs, players) including expansion and location of services (Darwish et al., 2013). Thus, the success of any marketing operation depends on providing a place or access to the product, or the way the product is delivered to the concerned authorities, whether they are individuals, groups or even the whole community.

Therefore, sports distribution that contributes to social inclusion is the means through which sports programs can be accessed; it may be any of the organisations through which sports services are provided.

The importance of sports distribution is based on decisions related to the appropriate distribution outlets for the target parties, in addition to the services associated with the process of spreading the idea and concept of social integration using appropriate means to communicate it, with the need to train and introduce the target parties to use them in the desired way to achieve social integration. Among the dimensions of social integration is the lack of class privileges in society, and it has been shown that sport forms organized lines that represent a classification of social classes very clearly, and many studies have even indicated the difficulty of having a

recreational activity that is not built in this way. The era in which sport in Western societies was a class privilege or the monopoly of a class in itself is over.

In this aspect, the issue of quality of service and efficiency in reaching the specific form of the various social classes without any error or deficiency is addressed. This is what the distribution system seeks to achieve in sports marketing because it focuses on the intangible aspects of distribution channels, and the ideas or goals set in the distribution program are able to reach all social classes without discrimination and thus achieve social integration.

On the other hand, when carrying out the process of sports distribution, several points must be taken into account, the most important of which are: developing a distribution policy that reduces the effort and time in obtaining the sports service or product; increasing the number of ticket outlets for festivals, tournaments, and matches; outsourcing distribution agents for the distribution of sports services; carrying out periodic studies on the adequacy and efficiency of ticket outlets; conducting periodic studies on sports services that satisfy the needs and desires of the beneficiaries and the extent of their satisfaction; studying the environmental conditions of the viewing audience and their direct effects on the attendance rates of these tournaments; and using technological means to attract the sports beneficiary to the sports service (Shafei, 2006).

Conclusions

Sports marketing does not only seek to achieve the objectives of the sports organization, but also aims to achieve the welfare and happiness of society through the responsibility entrusted to it, which starts from caring for the problems of society to reducing their effects, especially with regard to social integration.

The results of the research showed that there is an implicit relationship between sports marketing and the achievement of social integration, as sports marketing contributes to paying attention to the dimensions of social integration by adopting the social concept of sports marketing through the sports marketing mix, which consists of four basic elements, namely: sports product, sports pricing, sports promotion, and sports distribution.

The results of the research also confirmed that the contribution of the sports product to achieving social integration is through the provision of goods, services and ideas that include a set of characteristics to satisfy the needs and desires of individuals, the most important of which are the needs of acceptance and belonging. While the sports price contributes to achieving social integration through the benefits perceived by the target parties, which must be much higher than the material or moral cost paid for the success of the desired modification process in the desired social behaviour.

From the same perspective, sports promotion contributes to achieving social integration through cognitive and educational messages that seek to convey an idea that leads to and stabilises societal behaviour change. While sports distribution contributes to achieving social integration through its decisions on the appropriate distribution outlets for the target parties, in addition to the services related to the process of spreading the idea and concept of social integration using appropriate means to deliver it, with the need to train and introduce the target parties to use it in

the desired way to achieve social integration.

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The Impact of an Adapted Sports Activities Program on Developing Certain Motor, Skill, and Social Traits in Children with Down Syndrome

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Abstract: This study sought to evaluate the influence of a modified sports activities program on the enhancement of particular motor and social abilities in children with Down syndrome. The sample comprised ten youngsters aged 8 to 10 years. The researcher employed a series of motor skills assessments and a social skills scale, with the program executed over eight weeks, comprising three sessions weekly. The results indicated statistically significant enhancements in all assessed skills between the pre- and post-tests, with the post-test demonstrating superior outcomes. The enhancements were ascribed to the program's efficacy, which included activities centered on concentration, observation, and group interaction. The results underscore the significance of tailored physical activities in improving balance, locomotor speed, coordination, and social interaction in children with Down syndrome. The study advocates for the incorporation of adapted sports programs within educational and therapeutic frameworks for children with disabilities and proposes future research including bigger sample sizes and extended follow-up durations to substantiate the long-term impacts.

Keywords: adapted sports activities program, motor and social skills, children with down syndrome

Introduction

Regardless of whether a person has a physical, physiological, psychological, or social disability, many nations around the world have expressed a strong interest in them. The desire to make the most of their remaining skills and potential with the least amount of work is the source of this passion. All facets of society must work together to prepare these people and integrate them into the community in order to accomplish this aim (Mahy et al., 2010; Yu et al., 2022).

A disability is a condition that makes a person dependent on the help of others by limiting their capacity to execute one or more important daily living duties. Down syndrome, a chromosomal defect that impacts brain function and the nervous system, is one of the most prevalent intellectual disabilities, resulting in a variety of difficulties. This abnormality shows up as functional deficits, congenital organ

problems, and facial characteristics. As with other children, a kid with Down syndrome needs comprehensive training and care (Ulrich et al., 2001; Robles-Bello et al., 2020).

One of the biggest problems that children with Trisomy 21 experience is motor abnormalities. These conditions are typified by erratic, haphazard movements. These fundamental motions go from chaotic to more directed motions (Ulrich et al., 2001; Oreskovic et al., 2022). Recent research has shown that children with Down syndrome have problems with motor perception, especially in general balance, which impacts tasks including walking, hopping, throwing, standing, jumping, and balanced walking. These issues show up as frequent object collisions, walking difficulties, and difficulties with activities that require coordination of muscles (Connolly et al., 1993; Jobling & Cuskelly, 2006).

Deficits in social skills are also apparent in these kids, who have trouble interacting with others and playing in groups. This frequently leads to a failure to interact with peers in an effective manner (Mahy et al., 2010; Canales et al., 2021).

A key component of psychological therapy is physical activity, which mainly uses play to alleviate internal conflicts and emotions while also fostering motor skill development. Because it stimulates the senses, physical activity is therefore essential for motor perception training and physical education (Mahy et al., 2010; Fredes et al., 2021). By teaching kids how to use toys in a useful way, play can also help reduce stereotyped behaviours. This will eventually help them change their behaviour and stop doing the same things over and over again (Ulrich et al., 2001; Hendrix et al, 2021).

In light of this, creating structured, scientifically based motor activities specifically for kids with Down syndrome is crucial. In today's society, early childhood planning is essential since it helps youngsters acquire a variety of life concepts, experiences, and abilities (Connolly et al., 1993; Mahy et al., 2010).

Numerous research have looked at the effects of modified physical activities on people with Down syndrome, both domestically and abroad. The importance of family support and the necessity of specialised programs to increase physical activity participation were highlighted in a Saudi Arabian study that examined mothers' perceptions of physical activity levels, benefits, facilitators, and barriers for their children with Down syndrome (Alghamdi et al., 2021). Similar to this, Bricout (2015) highlighted the useful ways that sports can support good well-being in people with Down syndrome, proposing that prevention starts at birth and that parents should be taught constructive parenting techniques from an early age. Additionally, according to Muñoz-Llerena et al. (2024), physical education programs for people with Down syndrome should offer learning opportunities that go beyond simple game play in order to help them become physically educated individuals. In people with Down syndrome, modified physical activity regimens have also been shown to improve motor skills, balance, muscle tone, and strength, which fosters independence and self-reliance in day-to-day activities (Ma et al., 2024). To ascertain the impact of physical education and physical activity interventions on children with Down syndrome, Montalva-Valenzuela et al. (2024) conducted a meta-analysis of the literature, emphasising the significance of customised interventions in enhancing their physical

outcomes. The need for focused strategies to promote regular physical activity in this population is further highlighted by reports that children with Down syndrome engage in less physical activity than their peers, including those with other developmental delays (Chan et al., 2024). When taken as a whole, these studies highlight the many advantages of modified physical activities for people with Down syndrome, such as enhanced physical well-being, social engagement, and general quality of life.

Based on the researchers' experience working with this population and ongoing trips to specialised facilities, it has been noted that these facilities prioritise psychosocial treatment for this condition while ignoring its motor component. But the most important therapy components that can simultaneously support children's social and motor development are play and movement. Thus, by investigating how modified sports activities affect the development of specific motor and social abilities in kids with Down syndrome, the current study seeks to further this area for this population.

Materials and methods

The sample

Ten children with Down syndrome made up the research sample. They were chosen based on a number of requirements, such as having Down syndrome, being between the ages of eight and ten, not having any organic heart or chest diseases, and not having any additional intellectual or sensory disabilities. As indicated in Table 1, the research sample was homogenised according to study-related factors such as height, weight, and age. The study was conducted at the Elmachaal Association for Children with Autism and Down Syndrome in Sougueur, Tiaret, Algeria.

Table 1. Descriptive Statistics of the Research Sample Variables

Variable	Unit of measurement	Mean	Standard deviation	Median	Skewness coefficient
Age	years	9.12	0.34	9.00	0.647
Height	cm	122.1	3.68	122.00	0.123
Weight	kg	33.75	2.45	34.00	0.611

Table 1 makes clear that the values of the skewness coefficient varied from 0.123, which was the lowest, to 0.647, which was the highest. These numbers show that the research sample is homogeneous in these important factors because they fall between +3 and -3.

Research Tools

Motor Skills Tests

Based on scientific references (Hassan & Al-Mufti, 2004; Al-Hilali, 2004; Hassan, 2009), the researcher created a battery of tests to assess motor skills in children ages 6 to 10. A panel of knowledgeable professors reviewed these abilities and gave their approval, stating that they were appropriate for the sample's age and specificity (Table 2). The following tests were part of the battery:

Table 2. Battery of tests to assess motor skills

Skill type	Description	Objective
Balance skills	Walking on a balance beam	To measure balance
Locomotor Speed Skills	Standing long jump	To measure explosive leg power
Handling and Manipulation Skills	Throwing a ball with the hand / Throwing the ball upward and catching it	To measure arm explosive power / Accuracy in catching the ball

The validity and reliability of the tests were assessed using prior research and scientific references. By administering the tests (test-retest) to a sample of four youngsters from the research community who were not part of the main sample between October 10-18, 2024, the researcher was able to determine the test's reliability coefficient.

Table 3. Validity and reliability of motor skills tests

Skill / Test	Test 1 (M1 / SD1)	Test 2 (M2 / SD2)	Test Reliability	Test Validity
Walking on balance beam - Forward	1.75 / 0.50	1.94 / 0.43	0.82	0.72
Walking on balance beam - Backward	1.98 / 0.42	1.73 / 0.66	0.71	0.86
Walking on balance beam - Sideways	1.72 / 0.71	1.65 / 0.51	0.68	0.68
Standing Long Jump	1.69 / 0.67	1.75 / 0.53	0.80	0.89
Throwing ball with the hand	5.71 / 0.62	5.69 / 0.65	0.82	0.90
Throwing and catching ball upward	5.4 / 0.46	5.51 / 0.50	0.75	0.86

For the evaluated motor skills, the results in Table 3 show generally acceptable levels of test validity and reliability. Notably, tests like the standing long jump and throwing ball with the hand show good reliability (both > 0.80) and high validity (0.90 and 0.89, respectively), indicating significant consistency and relevance to the desired motor abilities. The Walking on Balance Beam-Sideways test, on the other hand, has the lowest validity and reliability (0.68 for both), suggesting that it may need to be further improved or standardised in order to improve measurement consistency. Although some tests may benefit from further development to improve psychometric qualities, overall, the results support the use of these tests, especially for the assessment of dynamic and gross motor skills.

Social Skills Scale

Social skills were measured using the Hassan (2009) scale. There are 27 objects total, spread across nine domains:

- Imitation
- Auditory response
- Play patterns
- Group activities
- Helping behaviors
- Non-verbal communication skills

- Joint attention skills
- Theory of mind skills

On a scale of 1 to 3, each item is given a rating based on how well it captures the child's behaviour. The replies are added up to determine the final score, which can go as high as 98. The reliability coefficient of the scale was (0.81). Hassan (2009) The specialist is responsible for filling out the scale.

Foundations of the Proposed Program

Using a variety of references and scientific sources, the researchers created a program of modified physical exercises designed to enhance specific motor and social abilities (Hassan, 2009; Al-Mufti, 2014). Experts and supervisors with expertise in the treatment and rehabilitation of people with impairments evaluated the program.

Several crucial prerequisites are included in the suggested program:

• Modified exercises that target every muscle and joint in the body, especially the upper body (arms, back, and abdomen).

• A range of focus and observation activities, as well as motor and sensory-motor games, to promote certain motor abilities (manipulation, handling, and balancing).

• Sufficient rest intervals of one to three minutes in between workouts.

• A training approach that is wave-like and used all week long.

Implementation of the Proposed Program

Over the course of eight weeks, from November 1, 2024, to January 5, 2025, the researchers implemented the suggested modified physical activities program three times a week, for a total of twenty-four training sessions for the experimental group.

The group took part in each 45-minute session while being closely watched by the researchers. The use of appropriate training techniques in the context of physical education and motor education was emphasised.

Three sections made up each session:

• Preparatory Section: Consists of both a general and targeted warm-up.

• Main Part: Using adjusted physical exercises and participating in chosen sports activities appropriate for the kids' skill levels to help them develop their social and motor skills.

• Final Section: Contains relaxing and calming techniques to help the kids get back to their regular selves.

The statistical analysis

The required statistical analyses for the study data were carried out using the SPSS software. In addition to the skewness coefficient, which measures how closely the distribution resembles a normal distribution, the mean and standard deviation were used to determine the trends of the responses and the extent of their dispersion. Additionally, the association between variables was examined using Pearson's simple correlation coefficient, and the significance of differences between group means was evaluated using the t-test.

Results

Analysis of the first hypothesis

There are statistically significant differences between the pre-test and post-test of the experimental group in motor skills.

Table 4. Presents the results of the pre- and post-tests for the experimental group in motor skills

Skill	Pre-Test (M)	Pre-Test (SD)	Post-Test (M)	Post-Test (SD)	df	Calculated t	Tabulated t	Significance at 0.05
Walking on the balance beam (forward)	2.29	0.24	2.75	0.52	08	3.52	2.77	Significant
Walking backward	2.11	0.42	2.35	0.69	08	5.04	2.77	Significant
Walking sideways	1.77	0.15	2.56	0.58	08	5.18	2.77	Significant
Jumping	1.25	0.25	1.81	0.78	08	4.56	2.77	Significant
Throwing a ball by hand	5.52	0.45	6.30	0.35	08	7.21	2.77	Significant
Throwing the ball upward and catching it	5.43	0.22	6.10	0.45	08	6.85	2.77	Significant

The experimental group's motor ability pre- and post-test results are shown in Table 4. With t-values ranging from 3.52 to 7.21 and all surpassing the tabulated t-value of 2.77 at the 0.05 significance level with 8 degrees of freedom, the results demonstrate statistically significant improvements in all six motor skills evaluated.

To be more precise, the average improvement in participants' forward walking speed on the balance beam increased from 2.29 to 2.75. This development points to better equilibrium and synchronisation. The notable improvements in mean scores (from 2.11 to 2.35 for backward walking and from 1.77 to 2.56) for sideways walking suggest an improvement in spatial orientation and lateral movement control, two essential components of physical agility. Better muscular coordination and leg strength were reflected in an increase in jumping ability, which went from an average of 1.25 to 1.81.

In terms of object handling abilities, the average scores for hand-throwing a ball and throwing it upwards to catch it went raised from 5.52 to 6.30 and 5.43 to 6.10, respectively. Improvements in motor planning, accuracy, and hand-eye coordination are indicated by these alterations. Although there were some increases in standard deviation, the tailored physical activity program was beneficial since there were consistent positive changes across all skills. The program's concentration on structured motor exercises requiring observation, focus, and engagement—thereby improving physical abilities through fun and purposeful tasks—is what the researcher says is responsible for these outcomes.

Analysis of the second hypothesis

There are statistically significant differences between the control group and the experimental group in social skills.

Table 5. Presents the results of the pre- and post-tests for the experimental group in social skills

Scale	Pre-Test (M)	Pre-Test (SD)	Post-Test (M)	Post-Test (SD)	df	Calculated t	Tabulated t	Significance at 0.05
Social skills	55.67	4.87	63.87	5.42	08	5.82	2.77	Significant

Table 5 presents the pre- and post-test results for the experimental group in social skills. The findings reveal a statistically significant improvement, with the mean score increasing from 55.67 in the pre-test to 63.87 in the post-test. The calculated t-value (5.82) exceeds the tabulated value (2.77) at the 0.05 significance level, with 8 degrees of freedom, confirming the significance of the result.

This marked increase indicates that the participants developed stronger social behaviors, including cooperation, communication, sharing, and empathy. The adapted physical activity program played a key role in fostering these improvements, as it involved activities that encouraged interaction, group participation, and mutual support. The inclusion of team-based and attention-focused tasks likely helped children engage more confidently with others, improving their social connections and emotional regulation. These findings support the second hypothesis and highlight the positive social impact of the sports-based intervention, which was not limited to physical development but extended meaningfully into the social domain.

Discussion

This study's results offer solid evidence of the beneficial effects of an adapted sports activities program on the enhancement of motor and social skills in children with Down syndrome. The results correspond with earlier studies that emphasize the essential function of physical activity in enhancing the motor and social skills of children with disabilities (Mahy et al., 2010; Bricout, 2015). The notable enhancements in motor skills, including balance, locomotor speed, and dexterity, align with the therapeutic benefits of play and exercise in fostering motor coordination and muscle strength (Ulrich et al., 2001; Ma et al., 2024).

The improvement of social skills, including communication, collaborative activities, and shared attention, further emphasizes the efficacy of physical activity programs in promoting social integration and communication among children with Down syndrome (Hassan, 2009; Canales et al., 2021). young enhancements are notably important considering the social obstacles young children frequently encounter, including issues in establishing peer relationships and participating in cooperative play (Mahy et al., 2010). The incorporation of focus and attention-oriented activities in the customized sports program likely facilitated these beneficial improvements, enhancing both physical coordination and social relations in group environments.

The program's success can be ascribed to its customized approach, which included exercises specifically intended for children with Down syndrome, according to their distinct needs and capabilities. The incremental, wave-like training approach facilitated suitable advancement, while the incorporation of both motor and sensory-motor activities ensured a comprehensive targeting of abilities. This comprehensive strategy, which harmonized physical activity with social interaction, fostered an environment favorable to both personal and communal development. The limited sample size and absence of long-term follow-up in this investigation may restrict the generalizability of the results. Additional study utilizing bigger sample sizes and extended longitudinal tracking is necessary to validate the enduring effects of these programs and investigate possible long-term advantages for children with Down syndrome.

Conclusions

This research illustrates the efficacy of a modified sports activities program in improving motor and social abilities in children with Down syndrome. The findings indicate that meticulously organized physical exercise programs tailored for this demographic can result in substantial enhancements in physical capabilities and social engagement, therefore fostering the overall development and welfare of these youngsters. The favorable results of this program highlight the significance of incorporating physical activity into the everyday routines of children with Down syndrome to promote motor and social development. Subsequent study ought to concentrate on increasing the sample size and investigating the long-term ramifications of these interventions. The findings underscore the necessity for educational institutions and therapy centers to incorporate adapted physical activities as an integral element of their programs for children with disabilities, thereby promoting a more comprehensive approach to their development.

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Yacht Tourism in the Tricity Area: A Comparative Study of Gdynia, Gdańsk and Sopot

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Abstract: Poland's northern regions, particularly the Tricity metropolitan area of Gdańsk, Sopot, and Gdynia, play a crucial role in the nation's yacht tourism and shipbuilding industries. Renowned for its maritime heritage and advanced yacht production capabilities, Poland is a leading European hub for manufacturing luxury yachts and outboard motorboats. This study examines the dynamics of yacht tourism in the Tricity area, highlighting the impact of geographical features, infrastructure, and natural conditions on yacht activity and distribution. The findings underscore Gdynia's prominence as the most advantageous location for yacht tourism, thanks to its naturally protected harbour created by a coastal spit. Gdańsk benefits from the Martwa Wisła River, offering sheltered docking areas, while Sopot, despite its recreational appeal, lacks the geographic advantages present in the other two cities.

Keywords: yacht tourism, Tricity area, coastal geography, maritime infrastructure, tourism dynamics

Introduction

Poland is Europe's largest producer of outboard motorboats and a key player in luxury yacht manufacturing. Much of its production is centred in the northern regions, including Pomerania (Gdansk, Gdynia), Western Pomerania (Szczecin), Warmia-Masuria (Ostroda, Olecko, Gizycko), and Podlasie (Augustow). Boasting a strong maritime tradition and advanced shipbuilding expertise, Poland is home to 112 yacht builders employing nearly 49000 workers and 121 marine equipment and accessory manufacturers employing an additional 6800 people.

In Poland, which the Baltic Sea strongly influences, summers are neither excessively hot nor dry. Particularly in the northern regions, maritime effects moderate the climate. Wide, flat, sandy beaches along the Baltic coastline create opportunities for sea tourism during the short summer season. This is also a significant

contributing factor to the mutual growth of yacht tourism (Duczyc & Wendt, 2019). Furthermore, the coastal cities of Gdansk and Gdynia (Rembarz, 2016; Karzyński, 2018), which constitute the focus of this study, are among the country's largest ports and trade centres (Atasoy et al., 2017a).

The coastal cities of Gdansk, Sopot, and Gdynia play a pivotal role in Poland's yacht tourism industry, each contributing uniquely to the region's appeal. With its rich cultural and historical heritage, Gdansk attracts visitors interested in a blend of tradition and modernity. Sopot, famous for its iconic pier and vibrant leisure activities, is a relaxation and water sports hub. With its strong maritime legacy and cutting-edge nautical events, Gdynia caters to yacht enthusiasts seeking modern facilities and dynamic competitions.

Tourism development, especially in regions with distinctive natural or cultural resources, is increasingly influenced by seasonal dynamics, technological innovation and economic dependencies. Recent studies highlight how tourism infrastructure and environmental conditions shape the spatial distribution of visitors and regional attractiveness, especially in areas dominated by specialized forms of tourism, such as winter sports or cultural heritage (Herman et al., 2021a and b; Caciora et al., 2021). Tourist perceptions and mobility behaviour are essential in underpinning tourism management strategies (Herman et al., 2021c), and long-term trend analysis provides valuable insights into tourism flows and future development directions (Caciora et al., 2024). These findings provide a relevant conceptual and methodological framework for analysing coastal tourism dynamics, such as those observed in yacht tourism in the Tricity area.

Figure 1. Location map of the work area

The Tricity metropolitan area, comprising Gdańsk, Gdynia, and Sopot, is located within the Pomeranian Voivodeship in northern Poland. Spanning a combined area of 414.81 square kilometers, these cities are situated along the southern coast of the Baltic Sea, at approximately 54°26′N latitude and 18°33′E longitude (Map 1). Their proximity and shared geographical features create a unified urban region with distinct

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roles and contributions. As the largest and oldest city in the Tricity area, Gdańsk is the capital of the Pomeranian Voivodeship. Gdańsk's extensive port facilities have historically facilitated trade and cultural exchange between Northern and Western Europe. The Martwa Wisła (Dead Vistula), a significant branch of the Vistula River, connects the city to Poland's interior, reinforcing its role as a vital trade and logistics hub. Situated northwest of Gdańsk along the shores of Gdańsk Bay, Gdynia has evolved from a small fishing village into a modern port city. This transformation, particularly after Poland's independence in the early 20th century, positioned Gdynia as a centre for shipping, logistics, and industry. Its port, one of the largest on the Baltic Sea, complements Gdańsk's maritime infrastructure and supports regional economic activities, solidifying the Tricity's importance as a key economic zone. Positioned between Gdańsk to the southeast and Gdynia to the northwest, Sopot is a coastal town renowned for its tourism and leisure industries. Defined by sandy beaches and the Baltic Sea's scenic coastline, Sopot attracts domestic and international visitors. Its central location within the Tricity region and its proximity to natural attractions such as the Tricity Landscape Park enhance its appeal as a destination for recreation and cultural activities (Cieplińska & Jarosz, 2021).

Figure 2. Aerial view of the Gdynia Yacht Port - modern infrastructure and high density of boats (Source: https://yachtstyle.co/country-profile-poland-2022/)

Modern cities, as chaotic arenas where culture, identity, and symbols coexist and compete, also serve as fertile grounds for diverse lifestyles and cultural richness (Türkoğlu & Elmastaş, 2022). Similarly, the coastal cities of Gdansk, Sopot, and Gdynia exemplify this dynamic through their yacht tourism. Each city, with its unique cultural and historical identity, contributes to a vibrant local economy shaped by the demands of the yachting industry. These urban spaces foster economic microzones centred around marinas and tourism and reflect the cultural diversity and modern lifestyles of yacht tourism.

This study aims to comparatively analyse the development of yacht tourism in the Tricity area (Gdynia, Gdańsk and Sopot) by examining the influence of natural geography and infrastructure on yachting activity, under the hypothesis that Gdynia, due to its sheltered natural harbor, will register the highest concentration of yachts; Gdańsk will present a moderate level due to river access; and Sopot, lacking natural advantages, will rely mainly on artificial facilities and recreational attractions.

Methodology

This study employed a comparative approach to analyse yacht tourism across the cities of Gdansk, Sopot, and Gdynia during three key periods: before the long weekend, during the long weekend, and after the long weekend. The primary focus was observing yacht numbers, categorising them into "with vessel" and "without vessel," and identifying movement and distribution patterns among the three cities. These observations served as the foundation for deriving statistical data.

To achieve this, data were systematically collected and analysed using statistical methods. These methods enabled the quantification of key variables and the identification of trends over time. The comparative approach was central to the study, as it facilitated the evaluation of differences and similarities in yacht activity between the three cities and across the specified periods. Visual tools such as maps, charts, and graphs were employed to enhance the clarity and interpretability of the data. By leveraging a combination of these techniques, the research aimed to offer meaningful insights into the dynamics of yacht tourism and its fluctuations in response to temporal and locational factors.

Results and discussions

A study assessed the distribution and characteristics of yachts in three locations: Sopot, Gdynia and Gdańsk, across three different periods before, during, and after a long weekend.

Table 1. The number of yachts in Gdansk, Sopot and Gdynia on the first research, second and third

Number of yachts	Gdansk			Sopot			Gdynia		
	Total	Without vessel	With vessel	Total	Without vessel	With vessel	Total	Without vessel	With vessel
25.04.2024	28	24	4	25	18	7	198	157	41
02.05.2024	50	40	10	39	28	11	204	136	68
09.05.2024	46	37	9	76	54	22	250	153	97

In Sopot, the first observation, conducted on April 25 (before the long weekend), recorded 25 yachts, seven of which were accompanied by vessels. The second observation, conducted on May 2 (during the long weekend), showed an increase to 39 yachts, 11 of which had vessels. The third observation, carried out on May 9 (after the long weekend), recorded a further increase to 76 yachts, with 22 accompanied by vessels (Table 1-2).

In Gdynia, the first observation (April 25) identified 198 yachts in total, with 70 on the left side (11 accompanied by vessels) and 128 on the right side (30 accompanied by vessels). This resulted in a total of 41 yachts. The second observation (May 2)

recorded 204 yachts in total, with 94 on the left side (9 accompanied by vessels) and 110 on the right side (59 accompanied by vessels), resulting in a total of 68 yachts with vessels. The third observation (May 9) showed a significant increase to 250 yachts in total, with 90 on the left side (23 accompanied by vessels) and 160 on the right side (74 accompanied by vessels), summing up to 97 yachts with vessels (Table 1-2).

In Gdańsk, the first observation (April 25) recorded 28 yachts, 4 of which were accompanied by vessels. The second observation (May 2) showed an increase to 49 yachts, 10 of which had vessels. However, the third observation (May 9) recorded a slight decrease to 46 yachts, 9 of which were accompanied by vessels (Table 1-2).

Table 2. Total number of yachts in the cities on three dates

Date	Gdansk	Sopot	Gdynia
25.04.2024	28	25	198
02.05.2024	50	39	204
09.05.2024	46	76	250
Total	124	140	652

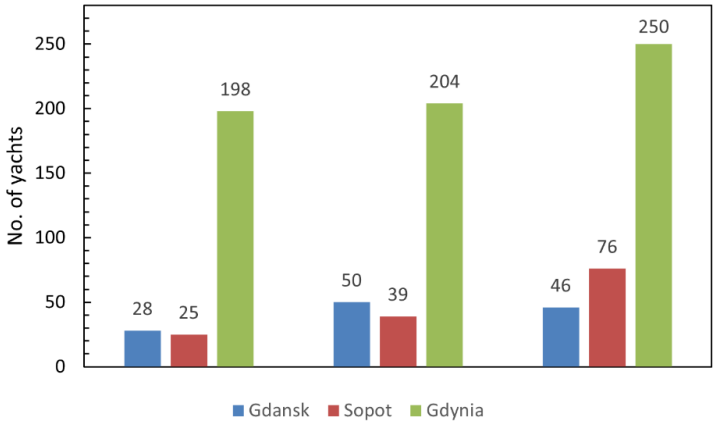

Figure 3. Comparison of the number of yachts in Gdańsk, Sopot and Gdynia before, during and after the long weekend

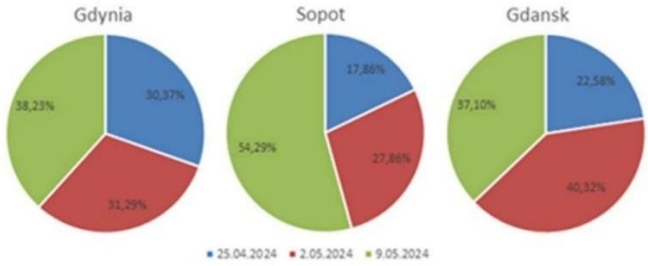

Figure 4. Percentage distribution of yachts observed in Gdynia, Sopot and Gdańsk at the three time points

Throughout the surveys, Gdansk accounted for 124 yachts, with 101 classified as "without a vessel" and 23 as "with a vessel." Sopot reported 140 yachts, comprising

100 "without a vessel" and 40 "with a vessel." Gdynia showed the largest number, with 652 yachts, including 446 "without a vessel" and 206 "with a vessel" (Table 1-2).

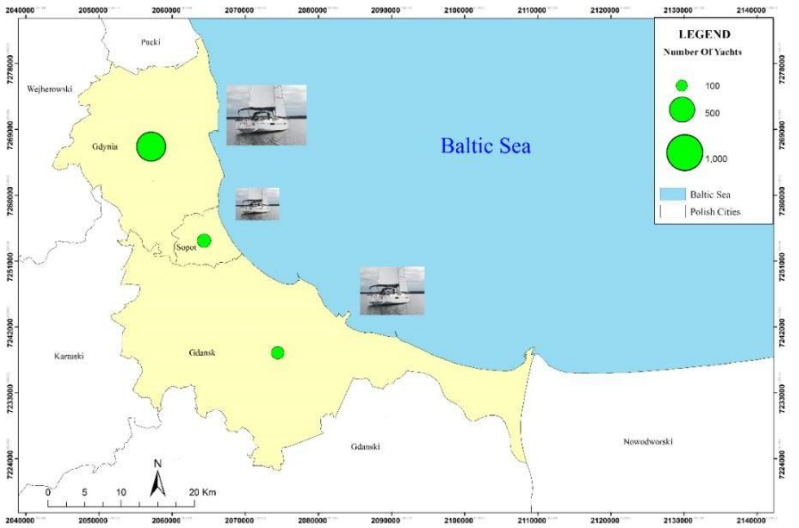

Figure 5. The number of yachts observed in Gdynia, Gdańsk and Sopot

When examining the coastal geographical features of the three cities, the prevailing wind direction in the north of Gdynia has enabled the formation of a coastal spit extending southeastward from the western part of the Gulf of Gdańsk. Based on the direction of the spit, the prevailing wind direction is NW-SE. The winds blowing from the Baltic Sea significantly impact the coastal shaping, or morphology, of the northern Polish coastline. These coasts are low-lying and shallow, with prominent depositional coastal forms (Komorowski, 2007; Kuliński & Kuliński, 2010).

The coastal spit and the water body to its south act as a barrier, breaking the impact of high waves from the open sea and creating a natural harbour. This feature makes Gdynia less affected by high waves thanks to the coastal spit.

Therefore, the sea and beaches are the most popular natural attractions in Gdynia. During the maritime tourism season, the average sunshine duration in Gdynia ranges from 228 to 236 hours, one of the highest among all coastal regions. Additionally, Gdynia and its water basins are characterised by the highest wind speeds in the area (m/s) and the most significant number of days with wind speeds exceeding 8 m/s. Such excellent wind conditions significantly contribute to the growth of maritime tourism and sailing activities (Atasoy et al., 2017b).

On the other hand, Gdańsk is more exposed to these high waves, as it lacks the natural wave-breaking effect provided by a coastal spit like the one in Gdynia. Therefore, it is less protected for small sea vessels, such as yachts, making it riskier for yachts to dock, with a higher chance of capsizing. For this reason, the number of yachts in Gdynia is higher, whereas it is lower in Gdańsk.

However, in Gdańsk, the Martwa Wisła River provides an outlet to the sea, which allows small vessels like yachts to operate. The city's location along this river ensures

that certain mooring areas are shielded from sea waves, providing a safe and protected zone for vessels of specific sizes to dock away from the impact of waves.

Additionally, the connection between the Gulf of Gdansk and the river network, along with the channels of Żuławy and the Great Masurian Lakes, supports the expansion of yachting activities in both the Gulf of Gdansk and the Masurian Lake region (Wendt & Wiskulski, 2017).

Conversely, Sopot does not have a natural harbour or a protected river system like Gdynia or Gdańsk. It only has artificial wave breakers and yacht shelters. Therefore, Sopot lacks the natural advantages that geography provides for yacht tourism. In Gdynia, the sea is calmer, allowing yachts to move freely, which is a positive outcome of forming the coastal spit.

As a result, Gdynia hosts a more developed yacht tourism industry and a significantly higher number of yachts than Gdańsk and Sopot. The natural coastal spit in Gdynia creates a calm and sheltered marine environment, ideal for yacht docking and operation. This geographical advantage protects yachts from high waves and offers favourable conditions for leisure and maritime activities. In contrast, Gdańsk, while benefiting from the Martwa Wisła River, cannot provide the same level of natural protection for yachts due to its greater exposure to open sea conditions. Similarly, Sopot relies solely on artificial wave breakers and lacks the inherent natural features that promote yacht tourism. Consequently, Gdynia stands out as the most favourable destination for yachts and yacht-related activities among the three cities, thanks to its naturally sheltered harbour and tranquil waters.

Conclusions

This study highlights the distinctive contributions of Gdynia, Gdańsk, and Sopot to Poland's yacht tourism sector, each influenced by their unique geographical and infrastructural features. Gdynia emerges as the leading hub for yacht tourism, driven by its naturally sheltered harbour, calm waters, and modern maritime facilities, offering optimal conditions for docking and yacht-related activities. Gdańsk, while lacking a natural spit, capitalises on the Martwa Wisła River to provide safe docking options for small and medium-sized vessels, sustaining its relevance as a cultural and logistical center. Conversely, Sopot relies on artificial structures such as wave breakers, limiting its capacity to compete with the natural advantages enjoyed by the other cities.

The comparative data analysis highlights Gdynia's dominance in yacht tourism, with higher numbers of yachts overall and those accompanied by vessels. This superiority stems from its advantageous maritime conditions and comprehensive infrastructure. In contrast, Gdańsk and Sopot primarily attract yachts through their cultural and leisure offerings rather than their geographical features.

By analysing patterns of yacht activity before, during, and after a long weekend, this study underscores the critical role of geography and infrastructure in shaping yacht tourism dynamics within the Tricity area. The findings advocate for continued investments in maritime infrastructure and strategic development to enhance Poland's growing reputation as a premier destination for yacht tourism in the Baltic Sea region.

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Spatial Distribution of Ski Slopes in Romania

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Abstract: Mountain spaces are fragile areas characterized by great ecological vulnerability. They have come to the attention of human concerns lately due to the need for new spaces. In this context, knowledge of the spatial distribution of ski slopes represents a significant indicator that can provide us with information on the extent of mountain tourism focused on practicing winter sports. From a methodological point of view, the analysis of spatial distribution was carried out at four levels of action: development region, county, locality and ski slope. The results obtained gave us a succinct and concise image of the spatial dimension of winter sports in Romania. To deepen the results thus obtained, new studies and research are needed on several directions of action with interdisciplinary research teams, a fact imposed by the complexity and importance of mountain space in protecting and preserving the environment.

Keywords: ski slopes, spatial distribution, mountain tourism, winter sports

Introduction

Tourism is an economic and social phenomenon representative of the contemporary era (Herman et al., 2024a, b; Nedelcu, 2015), which encompasses all the motivations and activities of a recreational and recuperative nature carried out in a certain territory, at a given time (Cocean, 2007; Herman et al., 2023; Herman et al., 2024c). In terms of time, it dates to antiquity, being practiced mainly by the elites of those times in the form of the Olympic Games, pilgrimages and medical trips (Ciangă and Deszi, 2007; Muntele and Iaţu, 2003). Today, tourism has become increasingly accessible to the masses of the population, amid the technical and technological advances recorded by human society, reflected in the modernization of infrastructure, and the duration of free time (Barros and Machado, 2010; Gondos and Nárai, 2019; Dickinson and Peeters, 2014; Sharpley, 2002; Tóth and Dávid, 2010).

In this article we will talk about mountain tourism, focused on practicing winter sports. The history of this category of tourism in Romania is relatively recent, namely

from the second half of the 19th century, when the first mountain tourist resorts were set up, Sinaia, Păltiniș and Semenic (Ciangă and Deszi, 2007). Over time, mountain tourism focused on practicing winter sports have experienced constant development in terms of quantity (number of ski slopes and related facilities, expansion of locations where new ski slopes have been set up in accordance with existing demand and needs) and quality (quality of existing slopes and facilities, existing services, etc.) (Ciangă and Răcășan, 2015; Gingulescu and Cocean, 2011; Herman et al., 2021).

Against this background, the development of tourism and its spatial expansion represent a defining constant of current societies characterized by economic, social and cultural prosperity. Within tourism, winter sports tourism plays an increasingly important role, requiring optimal orographic and climatic conditions, specific to mountain areas. In Romania, these can be found in an altitudinal range between 1500 – 1800 m, in the Eastern and Southern Carpathians, 1400 – 1600 m, in the Banat Mountains and between 1000 – 1600 m, in the Apuseni Mountains. This altitudinal differentiation, regarding the location of optimal conditions for the location of recreational ski slopes, is influenced by a series of factors, among which the dynamics of air masses and implicitly the precipitation regime are of major importance, both closely related to the latitude and longitude arrangement of the mountain ranges related to the Romanian Carpathians (Erdeli and Gheorghilaș, 2006; Ilieș, 2007).

Over time, mountain areas have been ideal spaces for practicing various forms of tourism focused on thermal tourism, climatism, mountain hiking, mountaineering, knowledge and more recently the practice of winter sports (alpine skiing, sledding, bobsleigh, etc.). The conquest and use of mountain spaces by tourism has been supported by the quality of the landscape and the access possibilities. The quality of the landscape is a motivational factor resulting from the multimillennial cooperation of natural and anthropogenic factors, while the access routes (road, railway, cable car) have facilitated the expansion of tourism in a space that is more difficult to access due to the morphometric characteristics, specific to the mountain space, which "is a special space, of great complexity and dynamism" (Cândea et al., 2006, p. 12).

The mountain space is defined by the existence of numerous resources with touristic valences, of orographic, hydrographic, climatic and biogeographic nature. The abundant existence of the typological categories of resources mentioned above has gradually led to the expansion of tourism in these mountain areas, bypassed until recently by man and his activities. Therefore, currently, the mountain space is a space of strong convergence and polarization of tourist flows, local, regional and global.

In this context, the purpose of this study is to obtain an image/radiography of the ski slopes in Romania. This is justified from the perspective of the weight and importance of tourism focused on winter sports, as well as the need for a scientific

allocation of the resources necessary for the consolidation and development of mountain tourist destinations.

Knowing the spatial distribution of ski slopes in Romania is an essential condition in the development of a tourism development strategy focused on winter sports, as a structural, integrated part of the tourism development strategy. The increasing importance of winter sports tourism from an economic, social and ecological perspective is a defining reality for Romanian and global society. Proof of this is the time allocated to ski holidays, as an expression of the adaptation of social needs to the local tourist offer.

In the specialized literature, the issue of ski slopes has been approached from various points of view, which focused on: the evaluation of ski potential (Gingulescu and Cocean, 2011a, b; Ilie, 2013; Popan, 2022), the efficiency of ski slopes (Cernaianu and Sobry, 2020; Bacoș and Gabor, 2021; Ilie et al., 2020; Yang and Wan, 2010; Teodor, 2016), the impact of ski slopes on the environment (Freppaz et al., 2013; Pintaldi et al., 2017), the characteristics of ski slopes (Lesenciuc et al., 2013; Voiculescu et al., 2011; Tofan and Păcurar, 2013), etc. However, the novelty of our study lies in the methodological approach to the analysis of the number, length and capacity of ski slopes in Romania at regional, county, locality and slope levels.

The research hypothesis assumed that ski slopes are unevenly distributed at a spatial level, with development regions, counties and localities that overlap a mountainous terrain being favored in this regard. Thus, through this research, we highlight the spatial distribution of ski slopes at the level of development regions, counties, localities and tourist regions focused on practicing winter sports in Romania.

Research methodology

Knowing the spatial distribution of ski slopes involved completing the following stages: identifying and collecting the information necessary to carry out the study (regarding number, length and capacity); systematizing, ranking and evaluating ski slopes according to the reference units targeted (development region, county, locality and slope); cartographic representation of ski slopes and analysis of the cartograms thus obtained.

The data necessary for the study were taken from the websites of the entities responsible for collecting and managing data on ski slopes in Romania (National Authority for Tourism; Tour - National Project of Tourist Information and Promotion; Ski in Romania; Tourist Romania Travel Agency), in the time interval January-February 2025, and the boundaries of the reference units in digital format (shapefile) were downloaded from ANCPI on March 21, 2025. The software used was Excel (for the primary analysis aimed at centralization, systematization and hierarchy) and ArcGIS PRO 3.4 (for the spatial rendering in cartographic form of the distribution of ski slopes in Romania).

Results and discussion

In Romania, in 2024, there were 229 ski slopes, with a length of 262,086.34 m, in an altitudinal range between 387 m (The Cozla 1, Cozla 2 Ski Slopes in Piatra Neamț, Neamț County) and 2,200 m (The Curba de Nivel-Pilon 2 Slope, Bâlea Lac, Sibiu County). The skiable area related to them was 1077.92 ha, with an optimal daily capacity of 188,983 skiers. Regarding the level of difficulty, there were 3 typological categories: easy slopes (88 units, 63,470.4 m, with an optimal daily capacity of 64,190 skiers), medium slopes (101 units, 136,750.74 m, with an optimal daily capacity of 88,163 skiers) and difficult slopes (40 units, 61,865.2 m, with an optimal daily capacity of 36,630 skiers).

The mobility of winter sports practitioners in Romania was facilitated by the existence of 208 cable transport installations with a length of 172,630.89 m and a capacity of 137,490 seats. The cable transport installations in Romania that served the ski area were represented by 6 cable cars (15,605 m long, capacity 3,470 seats), 11 gondolas (24,246 m long, capacity 16,500 seats), 39 chairlifts (46,145.34 m long, capacity 37,236 seats), 214 ski lifts (81,026.55 m long, capacity 72,408 seats) and 28 children's ski lifts (5,608 m long, capacity 7,876 seats).

To streamline tourist and sports activities, the ski slopes were equipped with 86 nighttime facilities and 127 artificial snowmaking facilities.

Table 1. Defining indicators

	Number	Length	Capacity
Ski slopes	229	262,086.34	188,983
Cableway installations	208	172,630.89	137,490
Nighttime installations	86	-	-
Artificial snow making facilities	127	-	-

Analysis of ski slopes at the level of development regions

Development regions are spatial entities that extend over the areas of several counties, created through their free association, having as their European equivalent in the nomenclature of territorial statistical units the NUTS II level (Sandu, 2011; Haller, 2017). They were established based on Law no. 151/1998 (on regional development in Romania) amended by Law no. 315/2004 (on regional development in Romania), in accordance with EC Regulation no. 1059/2003, on the establishment of a common system for the statistical classification of territorial units (Butnaru and Niță, 2016).

The importance of analyzing the ski area at the level of development regions is evident from the perspective of the place occupied by winter sports tourism at the regional level, from an economic, social and ecological point of view. The development and responsible management of the ski area most often requires a strategic regional

approach, given that its surface exceeds the boundaries of the county, as well as the necessary economic, human and technological capacities.

Having relatively large surfaces, the natural setting of the development regions is diversified, including plains, plateaus, hills and mountains. Out of the total of 8 development regions that are part of the structure of Romania, six regions have mountain units on their territory that have facilitated the practice of winter sports, given the demand for this sector.

The analysis of the distribution of ski slopes at the level of development regions highlighted the existence of oscillations in the hierarchy of reference units depending on each parameter analyzed (number, length, capacity and typology). However, the predominance of ski slopes can be observed in the Center, North-West and West regions, followed by the North-East, South and South-West (figure 1).

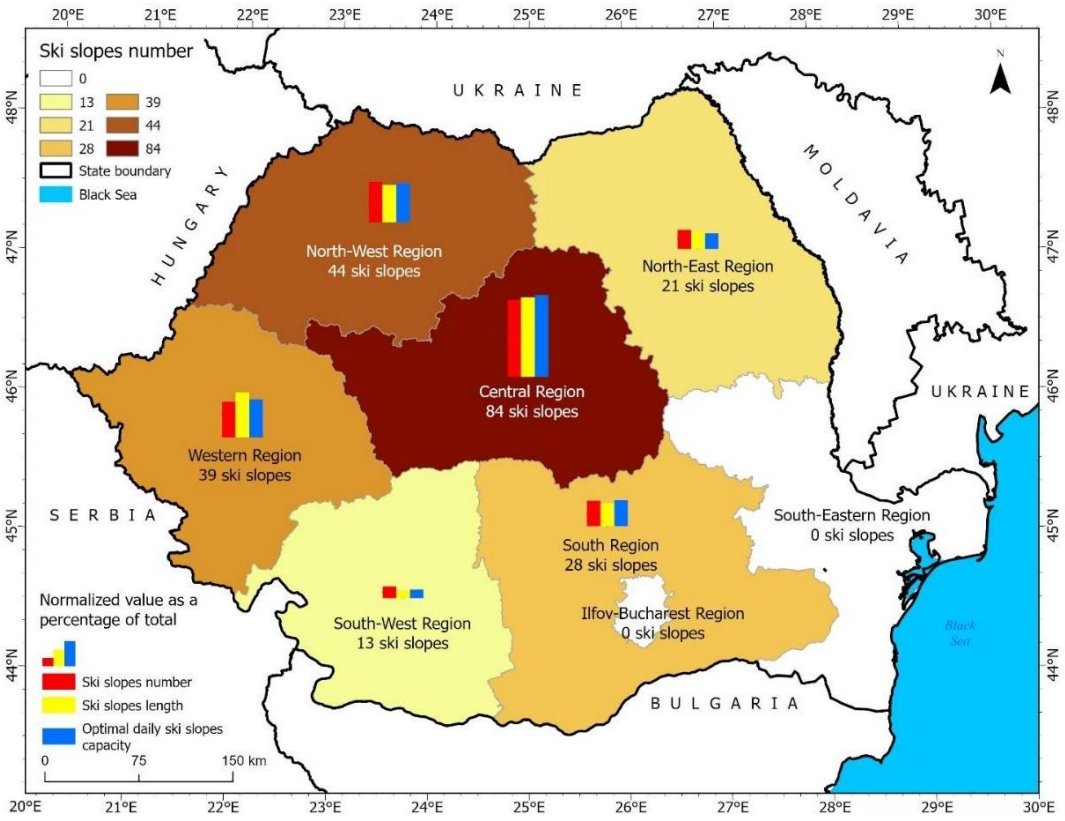

Figure 1. Distribution of ski slopes at the level of development regions

The analysis of the distribution of the number of ski slopes at the level of development regions indicates the existence of the following hierarchy: Center (84 units, 99,172.1 m long, 374.77 ha surface area and 73,680 persons optimal daily capacity), North-West (44 units, 46,379 m long, 160.96 ha surface area and 35,260

persons optimal daily capacity) and West (39 units, 56356.3 m long, 304.5 ha surface area and 34,160 persons optimal daily capacity), followed by the South regions (28 units, 28,660.54 m long, 121.4 ha surface area and 23,580 persons optimal daily capacity), North-East (21 units, 21,644.4 m long, 76.14 ha surface area and 14,263 persons optimal daily capacity), South-West (13 units, 9,874 m long, 40.15 ha surface area and 8,040 people optimal daily capacity). No ski slopes have been arranged in the Ilfov – Bucharest and South – East regions (figure 1).

The Central, North-West and West development regions concentrate 73% of the total number of ski slopes, respectively 77% of the length and 76% of the total capacity of ski slopes in Romania, being served by 91 (72%) artificial snowmaking facilities, 67 (78%) nighttime facilities and 161 (77%) cable car facilities, with a length of 39,687.89 (77%) m and a capacity of 38,040 (72%) people.

The Center Development Region, with an area of 34,100 km^2 and a population of 2,288,061 (12.0%) inhabitants (POP108D, 2025), overlaps the administrative-territorial boundaries of the counties of Alba, Brașov, Covasna, Harghita, Mureș and Sibiu, with a density of 67.1 inhabitants/km^2. From an orographic point of view, it is represented by the Carpathian Mountains (South-West of the Eastern Carpathians; North-East of the Southern Carpathians; South-East of the Apuseni Mountains) and the Transylvanian Depression (Southern part of the Transylvanian Depression). In the mountainous area of the Center Development Region, 84 ski slopes with a length of 99,172.1 m and a daily capacity of 73,680 skiers have been arranged. From a typological point of view, easy slopes dominate (38 units), followed by medium (34 units) and difficult (12 units). The cable transport facilities that serve them are represented by 54 ski lifts (31,352 m long, 32,606 seats capacity), 13 baby ski lifts (2,890 m long, 3,950 seats capacity), 8 chair lifts (8,310 m long, 8,358 seats capacity), 5 cable cars (1,770 m long, 14,216 seats capacity) and 2 gondola lifts (2,300 m long, 3,940 seats capacity).

The North-West Development Region, with an area of 34,159 km^2 and a population of 2,539,784 (13.3%) inhabitants (POP108D, 2025), overlaps the administrative-territorial boundaries of the counties of Satu-Mare, Maramureș, Bihor, Sălaj, Bistrița-Năsăud and Cluj, with a density of 74.4 inhabitants/km^2. From an orographic point of view, it is represented by the north-west of the Eastern Carpathians (Oaș Mountains - Igniș, Gutâi and Țibleș, Maramureș Mountains, Rodnei Mountains, Tibleș Mountains, Bărgăului Mountains), the north of the Apuseni Mountains (Pădurea Craiului Mountains, Plopiș, Meseș, Bihor Vlădeasa Mountains, Gilăului Mountains, the north of the Codru-Moma Mountains), the north-west of the Transylvanian Depression, the north of the Plain and the Western Hills. In the North-West Development Region, 44 ski slopes with a length of 46,379 m and a daily capacity of 35,260 skiers have been arranged. From a typological point of view, medium slopes

dominate (20 units), followed by easy (13 units) and difficult (11 units). The cable transport facilities that serve them are represented by 18 ski lifts (12,115 m long, 10,522 seats capacity), 12 chair lifts (16,152 m long, 11,353 seats capacity), 5 baby ski lifts (583 m long, 1,006 seats capacity), 1 gondola lift (2,600 m long, 1,800 seats capacity), located in Borşa, Maramureş County.

The West Development Region, with an area of 32,028 km^2 and a population of 1,672,978 (8.8%) inhabitants (POP108D, 2025), overlaps the administrative-territorial boundaries of Arad, Timiş, Hunedoara and Caraş-Severin counties, with a density of 52.2 inhabitants/km^2. From an orographic point of view, it is represented by the southwest of the Apuseni Mountains (south of the Codru-Moma Mountains, the Zarandului Mountains, the Metaliferi Mountains), the Poiana Ruscă Mountains, the Banat Mountains (Semenicului, Aninei, Locvei, Dognecei, Almajului Mountains) and the northwest part of the Southern Carpathians (Cernei Mountains, North of the Godeanu Mountains, Retezat Mountains, Tarcului Mountains, West of the Şureanu Mountains), the south of the Plain and the Western Hills. In the North-West Development Region, 39 ski slopes with a length of 56,356.3 m and a daily capacity of 34,160 skiers have been arranged. From a typological point of view, medium slopes dominate (18 units), followed by easy (11 units) and difficult (10 units). The cable transport facilities that serve them are represented by 30 ski lifts (22,383 m long, 16,827 seats capacity), 10 chair lifts (10,670 m long, 6,500 seats capacity), 2 gondola lifts (6,030 m long, 3,400 seats capacity) and 1 baby ski (400 m long, 360 seats capacity).

At the opposite pole was the South-West Development Region, where 13 ski slopes with a length of 9,874 m and a daily capacity of 8,040 skiers were arranged. From a typological point of view, easy slopes dominate (8 units), followed by medium (4 units) and difficult (1 unit). The cable transport facilities that serve them are represented by 6 ski lifts (3,715.55 m long, 4,552 seats capacity), 3 baby skis (585 m long, 670 seats capacity), 2 chair lifts (2,149 m long, 3,400 seats capacity) and 1 gondola (1,992 m long, 2,200 seats capacity), located in Voineasa, Vâlcea County. The South-West Development Region, with an area of 29,212 km^2 and a population of 1,855,697 (9.7%) inhabitants (POP108D, 2025), overlaps the administrative-territorial boundaries of the counties of Gorj, Vâlcea, Mehedinţi, Dolj and Olt, with a density of 63.5 inhabitants/km^2. From an orographic point of view, it is represented by the southeastern part of the Southern Carpathians (Mehedinţi Mountains, Vâlcanului Mountains, Parâng, Căpăţăni, Lotrului and the southwestern part of the Făgăraş Mountains), the western plateau and the Getic Subcarpathians and the western Romanian Plain.

Analysis of ski slopes at county level

Counties are spatial realities that emerged following the administrative-territorial reforms of Romania in 1968, 1981 and 1997, so that currently the territory of Romania is divided into 42 counties (Law 2, 1968; Decree 15, 1981; Law 50, 1997). The analysis of ski slopes at county level revealed that the largest number of ski slopes was in Harghita County (28 ski slopes), Prahova (27 ski slopes), Braşov (25 ski slopes) and Maramureş (24 ski slopes), while the smallest number of ski slopes were in Argeş, Bacău and Satu Mare counties, each with one ski slope (figure 2). We note that 21 counties (50%) do not have such facilities, which is justified by the orographic conditions specific to plain and hill units.

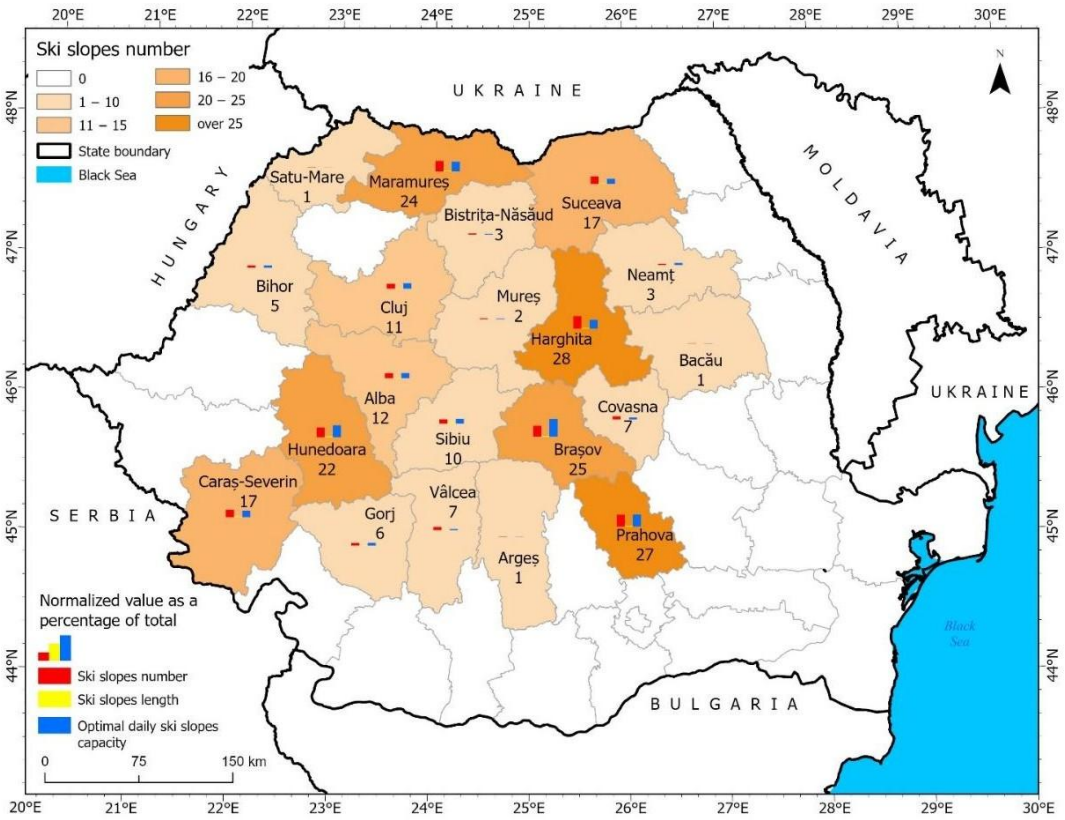

Figure 2. Distribution of the number of ski slopes at county level

Harghita County has the largest number of ski slopes (28 units), with a length of 18,913 m and an optimal daily capacity of 16,060 skiers. Located in the Ghurgiu, Giurgeului, Harghita, Ciuc and Ciomatu Mountains, the ski slopes are equipped with 29 cable transport facilities (16,180 m long with a capacity of 14,720 seats), 14 nighttime facilities and 16 artificial snowmaking facilities.

Prahova County ranked second in terms of the number of ski slopes (27 units), with a length of 28,110.54 m and an optimal daily capacity of 22,780 skiers. Located in the Bucegi and Bai Mountains, the ski slopes are equipped with 13 cable transport facilities (11,720 m long with a capacity of 11,890 seats), 5 nighttime facilities and 13 artificial snowmaking facilities.

In third place in terms of the number of ski slopes was Brașov County with 25 units, with a length of 29,120 m and an optimal daily capacity of 33,280 skiers. Located in the Bucegi, Piatra Craiului, Postăvaru and Făgăraș Mountains, the ski slopes are equipped with 28 cable transport facilities (26,380 m long with a capacity of 20,422 seats), 7 nighttime facilities and 17 artificial snowmaking facilities.

The three counties analyzed, although they represent only 7% of all counties, have 35% of all ski slopes in Romania, respectively 34% of all cable car facilities, 30% of lighting facilities and 36% of artificial snowmaking facilities, which highlights the role of these areas for practicing winter sports.

At the opposite end were the counties of Argeș, Bacău and Satu-Mare, where one ski slope was built in each county.

The analysis of the number of ski slopes, at county level, by typological categories, highlighted five categories of units: very large (2 counties, 51 ski slopes with a length of 47,023.54 m and an average daily capacity of 38,840 people), large (3 counties, 71 ski slopes with a length of 81,090.3 m and an average daily capacity of 73,850 people), medium (2 counties, 34 ski slopes with a length of 47,735.4 m and an average daily capacity of 21,613 people), small (2 counties, 23 ski slopes with a length of 24,665 m and an average daily capacity of 19,990 people) and very small (10 counties, 36 ski slopes with a length of 29,614.1 m and an average daily capacity of 25,380 people) (figure 2).

Analysis of ski slopes at locality level

The localities are areas of maximum population concentration, 72 of which are also destinations for practicing winter sports. There are 14,216 localities in Romania, of which 791 localities (6%) are urban, the rest are rural localities (ADM101A, 2025). Ski slopes were in 72 localities, from 20 counties.

The most ski slopes were in the localities of Sinaia (18 units), Straja (10 units) and Șureanu (10 units), while the fewest were in 28 localities (one ski slope in each).

The Sinaia tourist resort, located in Prahova County, Bucegi Mountains mountain unit, has 18 ski slopes (with a length of 19,092.54 m and an optimal daily capacity of 16,680), respectively 7 cable transport facilities (with a length of 7,430 m and a capacity of 8,040 seats), 1 night facility and 6 artificial snowmaking facilities.

The Straja tourist resort, located in Hunedoara County, the Vâlcan Mountains unit, has 12 ski slopes (with a length of 20,405 m and an optimal daily capacity of

17,400), respectively 19 cable transport facilities (with a length of 18,553 m and a capacity of 14,557 seats), 6 nighttime facilities and 11 artificial snowmaking facilities.

The Şureanu tourist resort, located in Alba County, the Şureanu Mountains unit, has 10 ski slopes (with a length of 11,710 m and an optimal daily capacity of 8,500), respectively 3 cable transport facilities (with a length of 2,900 m and a capacity of 2,600 seats).

The analysis of the number of ski slopes at locality level highlighted the existence of five typological categories: very large (2 localities, Sinaia and Straja, 30 ski slopes with a length of 39,497.54 m and an optimal daily capacity of 34,080 people), large (4 localities, Păltiniş, Poiana Braşov, Predeal, Şureanu, 35 ski slopes with a length of 41,438 m and an optimal daily capacity of 45,280 people), medium (9 localities, 60 ski slopes with a length of 75,374 m and an optimal daily capacity of 40,310 people), small (11 localities, 40 ski slopes with a length of 29,803.4 m and an optimal daily capacity of 25,840 people) and very small (46 localities, 64 ski slopes with a length of 75,973.4 m and an optimal daily capacity of daily population of 43,473 people) (figure 3).

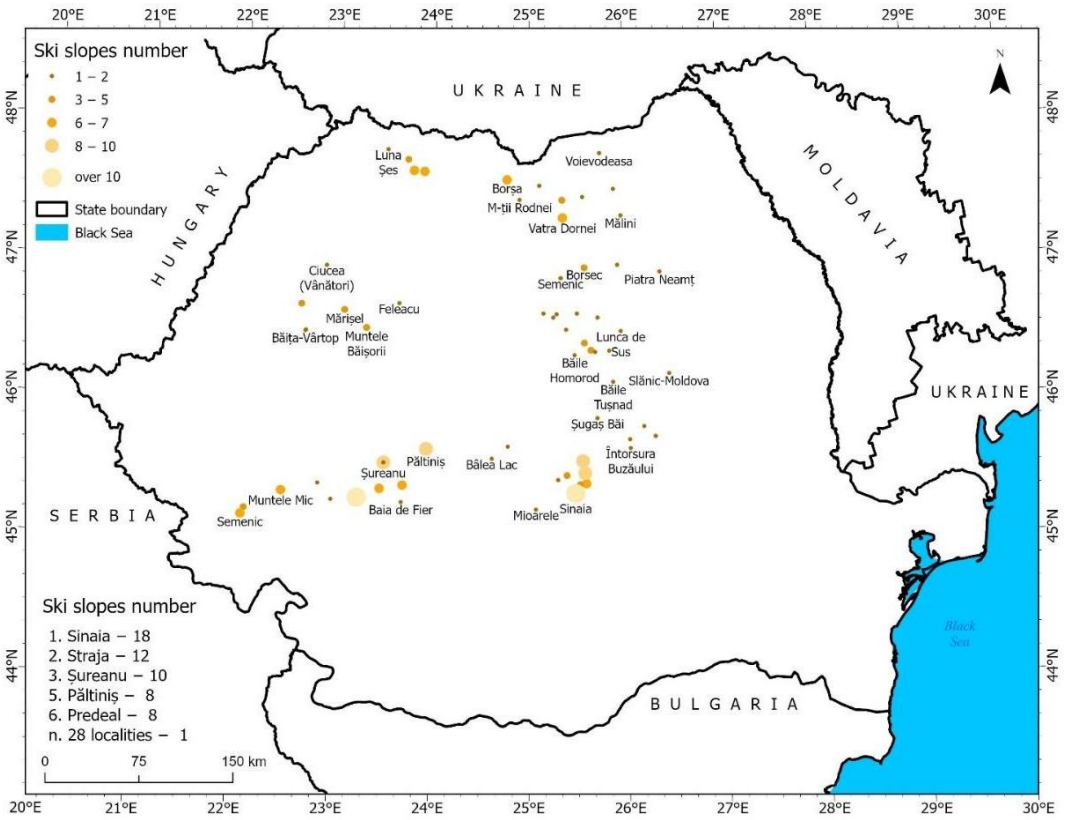

Figure 3. Distribution of the number of ski slopes at locality level

The longest ski slopes were located in the localities of Bâlea Lac (3 units, with a length of 27,000 m and a capacity of 2,000 people), Straja (12 units, with a length of

20,405 m and a capacity of 17,400 people) and Sinaia (18 units, with a length of 19,092.54 m and a capacity of 16,680 people) while the shortest were located in the localities of Ciceu (one ski slope, with a length of 270 m and an optimal daily capacity of 250 people), Comandău (one ski slope, with a length of 300 m and an optimal daily capacity of 500 people) and Întorsura Buzăului (one ski slope, with a length of 350 m and an optimal daily capacity of 500 people).

The analysis of the length of ski slopes at the locality level highlighted the existence of five typological categories: very large (2 localities, Bâlea Lac and Staja, 14 ski slopes with a length of 47,405 m and an optimal daily capacity of 19,400 people), large (5 localities, Borșa, Muntele Mic, Poiana Brașov, Sinaia, Șureanu, 50 ski slopes with a length of 76,488.54 m and an optimal daily capacity of 52,370 people), medium (8 localities, 52 ski slopes with a length of 55,973 m and an optimal daily capacity of 41,940 people), small (6 localities, 31 ski slopes with a length of 22,826.4 m and an optimal daily capacity of 25,690 people) and very small (51 localities, 82 ski slopes with a length of 59,393.4 m and an optimal daily capacity of 49,583 people) (figure 4).

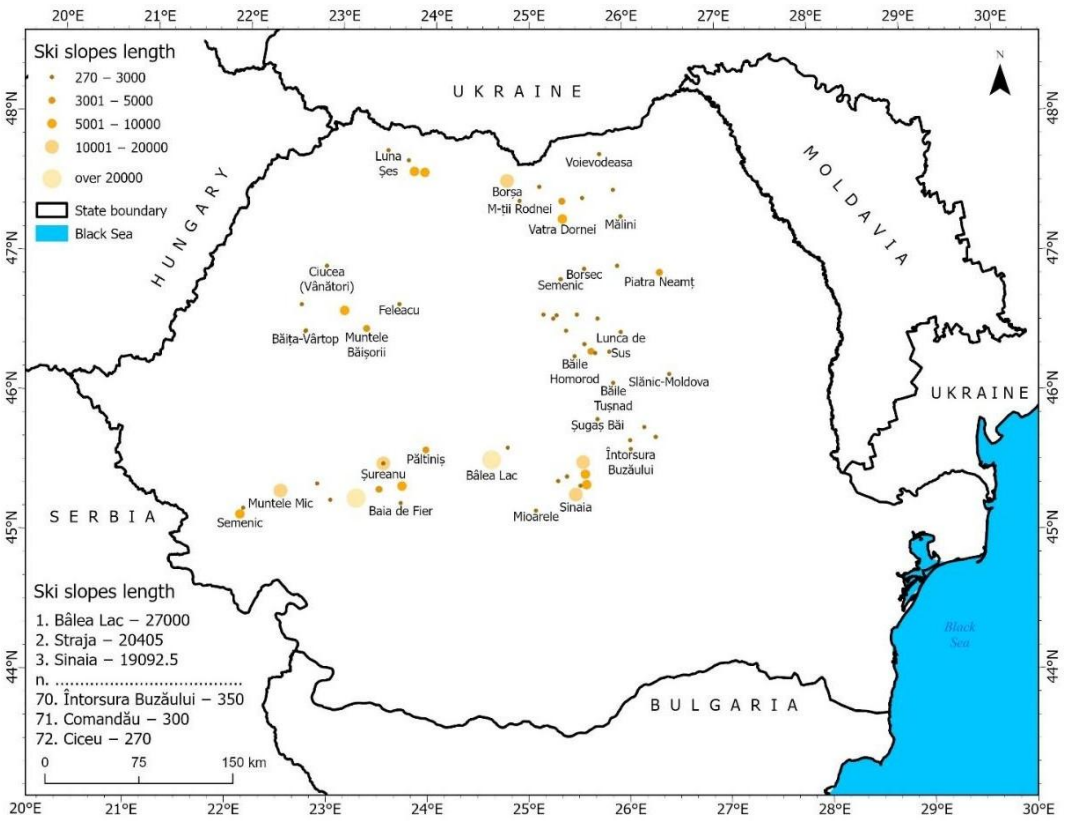

Figure 4. Distribution of ski slope length at locality level

The ski slopes with the highest optimal daily capacity were located in the localities of Straja (12 units, with a length of 20,405 m and a capacity of 17,400 people), Sinaia (18 units, with a length of 19,092.54 m and a capacity of 16,680 people) and Poiana Braşov (9 units, with a length of 16,240 m and a capacity of 14,920 people) while the ski slopes with the lowest optimal daily capacity were located in the localities of Durău (one ski slope, with a length of 406 m and an optimal daily capacity of 150 people), Vârşag (one ski slope, with a length of 1,050 m and an optimal daily capacity of 150 people) and Cheile Buţii (one ski slope, with a length of 400 m and an optimal daily capacity of 160 people).

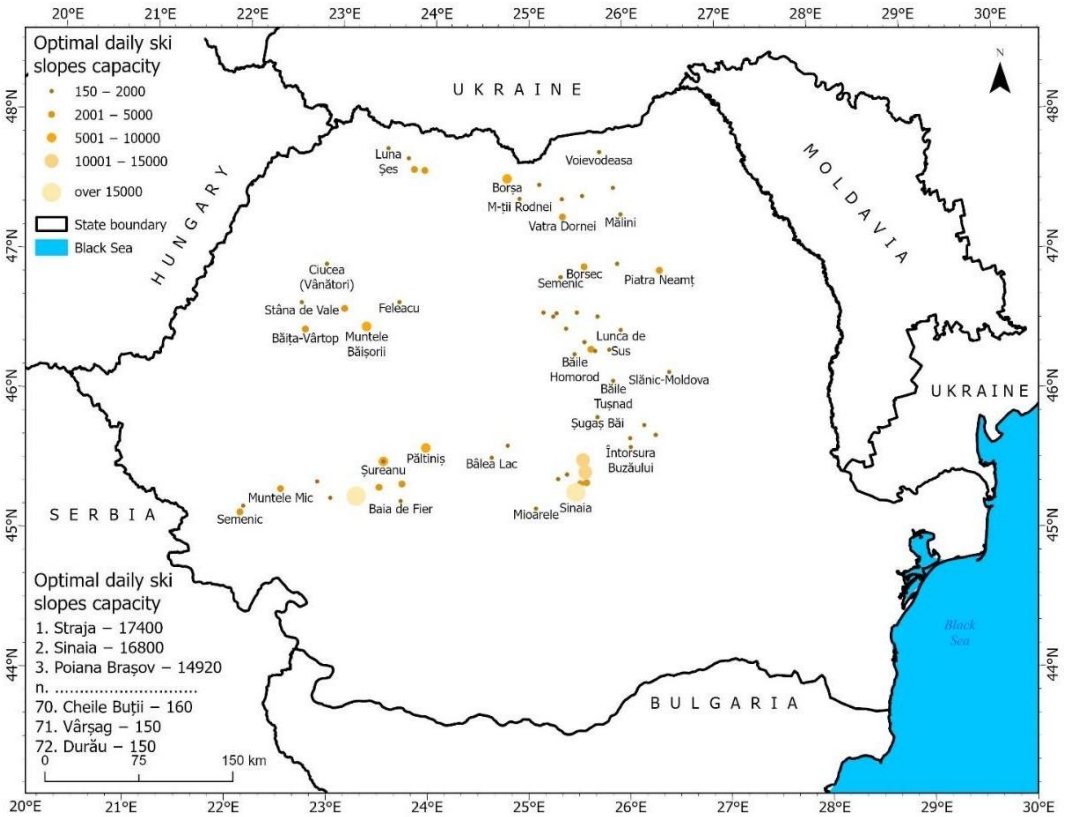

Figure 5. Distribution of optimal daily capacity of ski slopes at locality level

The analysis of the optimal daily capacity of ski slopes at the locality level highlighted the existence of five typological categories: very large (2 localities, Sinaia and Straja, 30 ski slopes with a length of 39,497.54 m and an optimal daily capacity of 34,080 people), large (2 localities, Poiana Braşov and Predeal, 17 ski slopes with a length of 24,770 m and an optimal daily capacity of 29,470 people), medium (3 localities, Borşa, Păltiniş and Şureanu, 25 ski slopes with a length of 27,718 m and an optimal daily capacity of 23,580 people), small (14 localities, 72 ski slopes with a

length of 83,049 m and an optimal daily capacity of 50,340 people) and very small (50 localities, 80 ski slopes with a length of 82,551.8 m and an optimal daily capacity of 45,713 people) (figure 5).

Ski slope analysis at the point level

The analysis of ski slopes at point level based on geographical coordinates (latitude and longitude) is essential from the perspective of investment management, respectively the spatial distribution of the specific related infrastructure.

The analysis of the density of ski slopes per km^2 highlighted the existence of seven agglomerations, tourist regions for practicing winter sports, namely: Prahova Valley, Southern Carpathians, Harghita Mountains, Maramureș, Bucovina, Semenic and Western Mountains (figure 6).

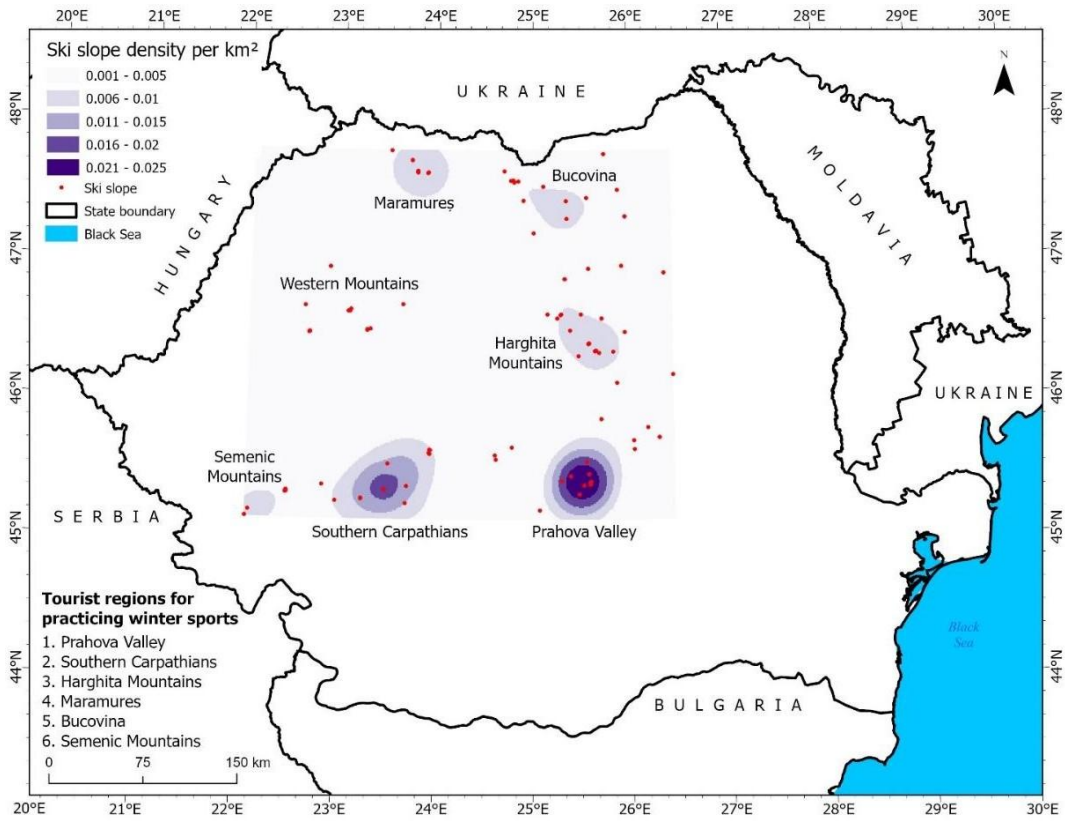

Figure 6. Density distribution of ski slopes

The tourist region of Valea Prahova is located on the border between the Central and Southern development regions, respectively at the contact between Brașov and Prahova counties, in the mountain units of the Bucegi Mountains, the Piatra Craiului Mountains, the Baiului Mountains and the Postăvaru Mountain. The ski slopes (52

units with a length of 57,230.54 m and an optimal daily capacity of 56,060 people) are grouped in seven localities, which also have the status of tourist resorts, namely: Poiana Braşov, Sinaia, Predeal, Azuga, Buşteni and Bran.

The Southern Carpathians tourist region is located at the border between the Central, West and South-West development regions, respectively at the contact between the counties of Hunedoara, Alba, Sibiu, Vâlcea and Gorj, in the mountain units of Şureanu, Cândrel, Lotrului, Căpăţânii, Parâng, Retezat and Vălcanului. The ski slopes (55 units with a length of 79,022.3 m and an optimal daily capacity of 47,910 people) are grouped in six localities, which also have the status of tourist resorts, namely: Straja, Parâng, Şureanu, Păltiniş, Voineasa and Baia de Fier. The Harghita Mountains tourist region is in the Central Development Region, in Harghita county, in the mountain units of Munţii Ghurgiului, Giurgeului, Harghitei, Ciuc and Ciomatu. The ski slopes (28 units with a length of 18,913 m and an optimal daily capacity of 16,060 people) are grouped in 15 localities, which also have the status of tourist resorts, namely: Băile Harghita, Băile Homorod, Băile Tuşnad, Borsec, Ciceu, Ciumani, Izvoru Mureşului, Joseni, Lunca de Sus, Mădăraş, Miercurea Ciuc, Praid, Topliţa, Valea Rece and Vărşag.

The Maramureş tourist region is in the North-West Development Region, in Maramureş county, in the Gutâi Mountains. The ski slopes (17 units with a length of 15,440 m and an optimal daily capacity of 10,740 people) are grouped in 3 localities, which also have the status of tourist resorts, namely: Cavnic, Izvoare and Mogoşa.

The Bucovina tourist region is in the North-East Development Region, in Suceava county, in Obcinele Bucovinei and the Suhard and Giumalău Mountains. The ski slopes (17 units with a length of 16,859.4 m and an optimal daily capacity of 9,513 people) are grouped in 7 localities, which also have the status of tourist resorts, namely: Câmpulung Moldovenesc, Cârlibaba, Gura Humorului, Mălini, Pasul Mestecăniş, Vatra Dornei and Voievodeasa.

The Semenic tourist region is in the West Development Region, in Caraş-Severin County, in Muntele Mic and the Semenicului Mountains. The ski slopes (17 units with a length of 30,876 m and an optimal daily capacity of 12,100 people) are grouped in 3 localities, which also have the status of tourist resorts, namely: Semenic, Brebu Nou and Muntele Mic. The Western Mountains tourist region is located on the border between the Central and North-West Development Regions, respectively at the contact between the counties of Bihor, Alba and Cluj, in the mountain units of Munţii Bihorului, Vlădeasa, Gilău and Muntele Mare. The ski slopes (17 units with a length of 15,615 m and an optimal daily capacity of 15,590 people) are grouped in six localities, which also have the status of tourist resorts, namely: Arieşeni, Băiţa-Vârtop, Ciucea (Vânători), Mărişel, Muntele Băişorii and Stâna de Vale.

Conclusions

The Romanian mountain space is a space of great complexity and ecological importance that hosts fragile ecosystems with rare species of flora and fauna, some of unique value. In this context, knowledge of the spatial distribution of ski slopes represents an essential component of information regarding the human impact on the environment, respectively the need for sustainable development of these spaces.

The analysis of ski slopes at the spatial level (development region, county, locality and slope) is an essential condition for the expansion and development of mountain tourism focused on practicing winter sports. Thus, the analysis of ski slopes, at the level of development regions, counties, localities and the slopes themselves, provided us with a database and an informative situation regarding the possibilities of practicing winter sports in Romania.

As a result of this study, the following conclusions were drawn:

- in 2024, in Romania, there were 229 ski slopes, occupying an area of 1,077.92 ha, with a length of 262,086.34 m and an optimal daily capacity of 188,983 skiers.

- in terms of difficulty, the 229 slopes were classified into 3 typological categories: easy slopes (88 units), medium slopes (101 units) and difficult slopes (40 units).

- the 229 ski slopes were served by 208 facilities with a total capacity of 137490 seats, 86 nighttime facilities and 127 artificial snowmaking facilities.

- the development regions with the largest number of ski slopes were the Center (84 units), Northwest (44 units) and West (39 units) regions.

- at county level, most ski slopes are in Harghita (28 ski slopes), Prahova (27 ski slopes) and Braşov (25 ski slopes).

- at locality level, most ski slopes were in Sinaia, Straja and Sureanu.

- the analysis of the density of ski slopes highlighted the existence of seven tourist regions focused on winter sports, namely: Prahova Valley, Southern Carpathians, Harghita Mountains, Maramureş, Bucovina, Semenic and Western Mountains.

The results obtained can constitute an informational support in the elaboration of the tourism development strategy of the mountain space, as part of the tourism development strategy in Romania. Since the mountain space is characterized by continuity and complexity, it does not take into account the administrative boundaries (region, county, locality), it is necessary to search for the most optimal ways to approach its sustainable development, including through tourism, seen lately as an important alternative in the development of local economies, in close correlation with the local supporting capacity. Therefore, development decisions should be centered on the local population and local decision-makers, in accordance with the profile demand in the immediate vicinity, especially in the urban environment.

The sustainable and responsible development of mountain tourism in Romania requires continued future research to establish the spatial relationships between ski slopes and cable transport infrastructure, as well as the relationships between ski slopes and tourist emission centers.

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