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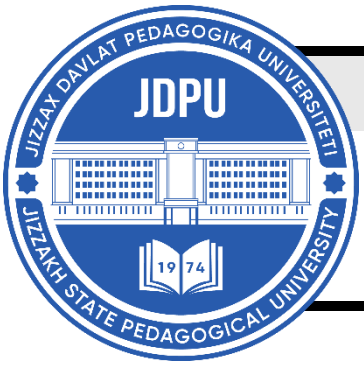

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THE ROLE OF 3D STRETCHING EXERCISES FOR STUDENTS ENGAGED IN SPORTS TOURISM

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ABOUT ARTICLE

Key words: 3D stretching, sports tourism, student, flexibility, injury prevention, muscle elasticity, posture correction, rehabilitation.

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Abstract: This article explores the significance of 3D stretching exercises for students engaged in sport-recreational tourism. It highlights their role in enhancing physical fitness, maintaining muscular elasticity, preventing injuries, and increasing the range of motion. The study analyzes the scientific and methodological foundations of these exercises and evaluates the effectiveness of integrating them into the educational process.

Relevance: Today, sports and health-improving tourism is recognized as an effective tool for promoting physical and mental well-being among university students and for fostering a healthy lifestyle. However, students engaged in sports tourism often experience muscle strain, impaired motor coordination, and micro-injuries due to the high level of physical activity. In particular, activities such as hiking, walking long distances with heavy backpacks, and moving across uneven terrain require complex, coordinated movements involving all parts of the body.

From this perspective, 3D stretching exercises allow for comprehensive preparation of muscles, ligaments, tendons, and joints by stretching the body in various planes. These exercises deepen the warm-up stage before training and accelerate the recovery process afterward, reducing the risk of injury and improving body balance and posture.

Currently, among athletes and coaches, there is a growing interest in 3D stretching techniques that involve movement in three planes, as opposed to traditional static or dynamic stretching exercises. Therefore, integrating these exercises into the training sessions of students engaged in sports tourism is a pressing scientific and practical issue. This approach not only enhances athletic performance but also significantly improves students' health and their engagement in the educational process.

In the Republic of Uzbekistan, the normative-legal documents adopted in the fields of domestic and pilgrimage tourism, as well as physical education and sports development, serve as a solid foundation for the integration of sports and health-improving tourism into the educational process. In particular, Presidential Decree No. PF-6165 dated February 9, 2021, marked an important step toward expanding domestic and pilgrimage tourism. Additionally, Presidential Decree No. PF-6097 dated October 29, 2020, approved the Concept for the Development of Science until 2030, which promotes innovative approaches in education and research. Moreover, Presidential Decree No. PF-5929 dated January 24, 2020, places special emphasis on promoting physical education and sports and encouraging a healthy lifestyle. Furthermore, Resolution No. PQ-3509 adopted on February 6, 2018, outlines measures to accelerate inbound tourism. These documents play a key role in encouraging the integration of sports and health-improving tourism into educational and upbringing processes, and in supporting youth physical activity and a healthy lifestyle.

Research Aim: The aim of this study is to explore the potential of using 3D stretching exercises for students engaged in sports and health-improving tourism, in order to enhance their physical fitness, improve the functional condition of muscles and joints, develop motor coordination and flexibility, and reduce the risk of injuries during sports activities.

Research Objectives:

To develop a set of 3D stretching exercises tailored for students;

To prepare recommendations for the integration of 3D stretching exercises into training sessions.

Research Results and Discussion. The research was conducted during the 2023–2024 academic year with the participation of students actively engaged in sports and health-improving tourism. The main goal of the study was to identify the positive effects of 3D stretching exercises on students' physical fitness, the functional state of the musculoskeletal system, and specific physical qualities related to sports tourism (agility, balance, flexibility, and endurance).

The study was carried out in the following methodological stages:

Theoretical-analytical stage: During this stage, previously studied scientific sources, stretching techniques—particularly the biomechanical and physiological foundations of 3D stretching—were analyzed. The impact of exercises and loads related to sports tourism on students was theoretically assessed.

Experimental stage: Students participating in sports and health-improving tourism classes were divided into two groups:

Experimental group: Performed 3D stretching exercises three times a week.

Control group: Performed only traditional warm-up exercises.

In both groups, various physical indicators (body flexibility, postural stability, muscle tone, and range of motion) were measured before and after the experiment.

Practical application: 3D stretching exercises adapted for sports tourism were incorporated at the beginning and end of training sessions. This helped prepare students' bodies for physical load and accelerated the recovery process.

Result analysis: In the experimental group, an average improvement of 15–20% in flexibility and muscle elasticity was recorded. Such results were not observed in the control group. Statistical analysis confirmed the high effectiveness of 3D stretching exercises.

Based on the study, a comprehensive set of 3D stretching exercises designed specifically for students involved in sports tourism was developed, and methodological guidelines for their practical implementation were formulated.

3D Stretching Exercise Complex for Students Engaged in Sports Tourism

Table 1

No	Name of the exercise	Parts of the body	"Description of Enhancing 3D Movement"	Time	Effect
1.	Rock climbing	Quadriceps, glutes, and thighs	Simulating a climb by alternately lifting the knees – movement in three planes: stepping forward (sagittal), shifting support (frontal), and rotating the torso (horizontal).	2 minutes	Enhances coordination and balance under varied terrain conditions
2.	Side jump	Gluteal muscles and lateral thigh muscles	Jumps with emphasis on lateral movement and slight torso rotation – frontal and horizontal	2 daq	Strengthens the lateral stability and mobility of the hip joint

			planes are actively engaged		
3.	Climbing balance	Calves, ankles, and feet	Standing on an unstable surface, we lift the opposite leg and rotate the torso – all three planes are engaged	2 daq	Improves balance and sensorimotor control
4.	Trunk rotations	Abs (or abdominal muscles), back, shoulders.	From a standing position, rotate the arms together with the torso, including bending and twisting – performing a 3D rotation of the torso	2 daq	Develops spinal mobility and trunk stability .
5.	Three-dimensional leg movement.	Thigh, buttocks, hips	Bending the torso and rotating the pelvis while pulling the legs forward, sideways, and	3 daq	Increases the range of motion in the hip joint

			backward – a complete example of 3D movement		
6.	Rotational sitting	Quadriceps, dumbbells, body.	We perform squats by twisting the torso and moving the arms in different directions – incorporating multi-joint 3D movements	3 daq	Reduces load on the knees and improves stability
7.	Hip and groin stretch	Pelvis, groin, lower back	From a wide-legged stance – bend and twist the torso diagonally. The 3D stretcher is activated.	2 daq	Improves the flexibility of pelvic muscles in various directions.
8.	Calf stretch	Calves, Achilles tendon 4o	Leaning against a wall, shift the pelvis diagonally forward and downward – stretch occurs	2 daq	Reduces tightness in the posterior chain of the leg.

			in the sagittal and frontal planes.		
9.	Quadriceps stretch	Anterior thigh muscles	Standing on one leg, pulling the other leg backward while bending the body along a circular arc – 3D muscle tensioning.	2 daq	Increases the range of motion in the hip, thigh, and knee joints.
10.	Stretching the back and shoulders	Back, shoulder, trapezius	From a seated position — bending forward and to the sides, rotating the torso while reaching out with the arms.	2 daq	Gentle 3D stretching of the spine and shoulders.
11.	Balancing on one leg.	Foot, ankle, thigh.	Standing on one leg, the other draws a circle while the body maintains balance — an exercise	2 daq	Strengthens small stabilizer muscles and the vestibular system

			involving all three planes of motion		
12.	Explosive jumps with rotation	Quadriceps, core, shoulders	We perform jumps with sharp torso rotation and direction changes – an explosive 3D load.	2 daq	Increases the reactive force and mobility of the joints.

The results of goniometric measurements showed that after the application of the 3D-stretching exercise complex, students demonstrated an average increase of 15–20% in joint range of motion. This is considered a positive indicator in terms of their readiness for functional movement and the reduction of injury risk.

Analysis of 3D Stretching Exercises for Students Engaged in Sports Tourism

2-table

Joint / Movement	**Group**	**Before research (M±SD)**	**After research (M±SD)**	**Δ (Farq)**	**n**	**P-value**	**Importance**
Neck joint (forward flexion)	Experimental group	42.5 ± 4.2	54.8 ± 3.7	+12.3°	83	**P<0.05**	Significant
	Control group	42.7 ± 4.1	44.1 ± 4.3	+1.4°	82	>0.05	Insignificant
Shoulder joint (extension)	Experimental group	148.3 ± 6.1	162.5 ± 5.4	+14.2°	83	**P<0.05**	Significant
	Control group	147.8 ± 5.9	149.1 ± 6.0	+1.3°	82	>0.05	Insignificant
Knee joint (flexion)		112.2 ± 5.7	128.6 ± 5.2	+16.4°	83	**P<0.05**	Significant

	Experimental group						
	Control group	113.1 ± 5.4	114.5 ± 5.5	+1.4°	82	>0.05	Insignificant

Conclusion

The conducted research showed that students engaged in sport and wellness tourism experience a high level of load on their musculoskeletal system during physical activity. This directly affects movement balance, flexibility, and muscle function. During the study, significant positive changes were observed in students' flexibility, balance, muscle relaxation, and postural stability through the use of 3D stretching exercises. The experimental results confirmed that the practical application of 3D stretching techniques in sport tourism training sessions is highly effective.

Thus, integrating these exercises into the educational process serves as an important factor in strengthening students' health and improving the quality and safety of training sessions.

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