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APPLICATION OF KINETIC RECOVERY PROGRAMS IN PERFORMANCE SPORTS DANCE PATHOLOGIES

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ABSTRACT. For the detection of the flat foot and ligament laxity, the method of visual observation of the anatomical landmarks, the planogram on paper and the test of bearing body weight were used. At the same time, to test the stability of the ankle joint, we used the unipodal test on Bosu ball, where it was measured in seconds how much the subjects managed to maintain the unipodal position on Bosu ball. For the detection of low back pain, the method of individual interviewing of each athlete, the VAS scale of pain, the DLLT test (Double Leg Lowering Test) and the visual evaluation of any malalignments present in the bone structures was used. Applying the protocol for flat foot pathology, we obtained an improvement of the plantar arch in all subjects, as evidenced by the improvement of paper planograms where the decrease of the plantar footprint on the medial part of the foot was observed in all subjects of the experiment group. Compared to the standard protocol applied to the control group, we obtained by applying our protocol an improvement of the Achilles tendon line in orthostatic in 9 out of 10 subjects, while when applying the standard protocol, only 7 out of 10 subjects were observed. In conclusion, applying the kinetic protocol to recover post-training low back pain has improved low back pain, proving to be more beneficial than the standardized protocol for dancers, especially for female subjects.

Keywords: *kinetic recovery, sport performance, dancers pathologies, sport traumatology.*

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REZUMAT. ***Aplicarea protocolului kinetic de recuperare în patologiile dansului sportiv de performanță.*** Pentru depistarea laxității piciorului plat și a ligamentelor s-au folosit metoda de observare vizuală a reperelor anatomice, plantograma pe hârtie și testul de susținere a greutății corporale. Totodată, pentru a testa stabilitatea articulației gleznei, am folosit testul unipodal pe mingea Bosu, unde s-a măsurat în secunde cât de mult au reușit subiecții să mențină poziția unipodală aceasta. Pentru a detecta durerile de spate au fost utilizate metoda de intervievare individuală a fiecărui atlet, scala de durere VAS, testul DLLT (Testul dublu de coborâre a picioarelor) și evaluarea vizuală a oricăror malalinieri prezente în structurile osoase. Aplicând protocolul pe care l-am creat pentru patologia piciorului plat, am obținut o îmbunătățire a arcului plantar la toți subiecții, dovadă fiind îmbunătățirea plantogramelor de hârtie unde s-a observat o scădere a impresiei plantare pe partea medială a piciorului la toți subiecții grupului experimental. În comparație cu protocolul standard aplicat grupului de control, am obținut prin aplicarea protocolului nostru o îmbunătățire a liniei tendonului lui Ahile în ortostatism la 9 din 10 subiecți, în timp ce aplicarea protocolului standard a fost observată la doar 7 din 10 subiecți. În concluzie, aplicarea protocolului kinetic de recuperare a lombalgiei post-exercițiu a adus un rezultat pozitiv în ceea ce privește ameliorarea lombalgiei, dovedindu-se a fi mai benefică decât protocolul standardizat pentru dansatori, în special pentru subiecții de sex feminin.

Cuvinte cheie: *recuperarea kinetică, sportul de performanță, patologiile dansatorilor, traumatologia sportivă.*

Introduction

The sports field has seen a significant expansion in the last two decades, refining itself physically and mentally and developing the quality of human motor skills to a higher level. Like any sport, performance sports dance also includes athletes' injuries resulting from some favourable factors such as incorrect warm-up, repeated poor execution of dance figures, lack of theoretical and motor knowledge of the dancers, and overstrain and over-training of the body. The position represents the two partners' external attitudes towards each other before and during the dance.

In standard dances, the primary position contains the following distinct elements: the partners stand face to face, with a slight lateral movement of the dancer to her left, to very quickly reach the right of the partner, and the knees of both partners are slightly bent, and the partner's knees will be positioned so that her right leg can move freely between the partner's legs, both partners must keep their shoulder blades down and their shoulders relaxed, the muscles of the arms, abdomen, back and lower limbs are in tension (we have a muscle tone above the usual standard limit); the line of the shoulders and hips is

horizontal, parallel to the floor and the two lines (of the hip and shoulders) of the partnership between the body of the partner and the partner there is contact in the pelvis area only up to the level of the pelvic girdle (the right side of the partner is in contact with the left side of the boy) (Năstase, 2002).

Looking at the anatomy of the foot, we note that it is made up of 26 bones arranged in 3 groups as follows (Andron & Reveica, 2003): the tarsus—contains seven bones: the talus, the calcaneus, the navicular, the cuboid and the three cuneiforms; metatarsus—contains the five metatarsals; phalanges - 14 in number. From an antero-external view, the astragalus articulates with numerous bones: tibia, fibula, calcaneus, and scaphoid. However, no muscle attaches to this bone. He mobilizes indirectly through his neighbours. It consists of a body, a head and a neck. On the superior and lateral faces, the elongated trochlea of the talus with the medial and lateral malleolar facet is found. The body forms with the neck at an angle of declination, open downwards and at an angle of inclination open medially (Avrămescu, 2003). The metatarsus contains five metatarsal bones, numbered I to V from medial to lateral, and are long, paired bones containing a head, a body, and a base (Papilian, 2003).

The spine has three main functions (Drake et al., 2020):

- the support function—supports the weight of the body, transmits various forces through the pelvis to the lower limbs, supports and moves the head and helps to manoeuvre the upper limbs;
- movement function (dynamic)—through the attached muscles;
- the protective function of the central nervous system.

The back muscles consist of the outside muscle group and the intrinsic muscle group (Drake et al., 2020): the extrinsic back muscles move the upper limbs and ribs; the intrinsic muscles of the back maintain the posture and contribute to the movement of the spine; these movements include flexion (anterior bending), extension, lateral flexion, and rotation (circumduction).

Pes planus - general aspects

Pes planus ("flat foot") as the lack in the medial longitudinal arch of the foot, heel valgus deformity, and medial talar prominence is all symptoms of this condition. The deformity is ordinarily asymptomatic and disappears within the first decade of life, evolving into a painful, rigid form that causes significant disability (Troiano et al., 2017). This pathology is common in children and adults (Michaudet et al., 2018). Thus, the arch of the plantar arch is erased, touching the ground and creating significant biomechanical changes in the body. There are two types of pes planus: the rigid type and the flexible type. In pes planus of the rigid type, there is a flattening of the plantar arch both when bearing body weight and without it.

In contrast, with a flexible or functional pes planus, the plantar arch is present when the foot is not weight-bearing or on a half-sole, but when the dancer is standing, the medial longitudinal arch flattens. This condition is widespread among dancers (Clippinger, 2007). From a practical point of view, flat feet appear in sports dance due to the foot technique used in Latin dances. The foot position in Latin dances is similar to the third position in ballet. Thus, the dancers' soles will form a "V" by opening the tips to the side, simultaneously changing the biomechanics of the steps.

Biomechanics of the Occurrence of Lumbago in Dance

Performance dancers spend much time in the ballroom using their most complex tool—the body. Sports dance is a sport practised through the total involvement of the dancers, both mentally and physically. So, on a physical level, all the body's parts are involved in the act of dancing, especially the spine. Because of its remarkable flexibility, the spine has become essential for dancers for two reasons. Firstly, biomechanically, it must fulfil the function of supporting the body through its strength, mobility and suppleness; secondly, it is essential to the aesthetics of motoring. The figures in performance sports dance require a sophisticated aesthetic, and the spine is subject to great demands to support the desired individual position of the trunk and the weight of the other partner in the more complicated figures (Clippinger, 2007).

Knowing the elements of posture used in standard dances, we thus identify the occurrence of lumbago through analysis. A study in Current Sports Medicine entitled "Spine Injuries in Dancers" reports that the spine is the second most affected area of the body due to problems arising from poor knowledge of the execution technique or weakness of the abdominal muscles (Gottschlich et al., 2011). The incorrect execution of the posture in standard dances foresees the occurrence of the following mistakes that favour the occurrence of lumbar hyperlordosis: inactivating the necessary muscle tone at the abdominal level, performing exaggerated extension in the girls towards the floor or projecting the body weight on the heels.

Research hypothesis

In the present research, we started from the hypothesis that, following the implementation of the kinetic protocols developed by us, we will obtain significantly better results among the experimental group, respectively a greater efficiency of our protocols in order to improve post-exercise lumbago and a verticalization external axis of the Achilles tendon.

Material and method

For the implementation of the two elaborated protocols, the following materials were used: a mattress; a small elastic ball; an elastic band; a stepper; a kettlebell; the trellis; a cylindrical foam roller of reduced diameter; a pencil; standard size medicine ball; a chair.

The visual observation method of anatomical landmarks, the planogram on paper and the body weight bearing test was used to detect flat feet and ligamentous laxity. At the same time, to test the stability of the ankle joint, we used the unipod test on the Bosu ball, where it was measured in seconds how long the subjects could maintain the unipodal position on the Bosu ball.

The method of individual interviewing of each athlete, the VAS pain scale, the DLLT test (Double Leg Lowering Test) and the visual evaluation of any malalignments present in the bone structures was used to detect lumbago.

As a comparison term for the kinetic protocols we developed, we chose two standardized exercise protocols that we applied to the control group. The standardized kinetic protocol for the recovery of the lower back includes the ten exercises created by Marius Militaru at the National University of Physical Education and Sport, and the standard kinetic protocol followed for the recovery of lumbago is the one created by Dr. Dan Valentin Anghelescu.

In the present work, 20 subjects aged between 10 and 16 years were included, divided into two groups of 10 subjects each (experimental and control groups). All subjects gave their consent for active participation in this study.

The method of carrying out the application of the two protocols is based on their practical application by the performance group of the dance club Dance Art from Târgu Mureş on its premises during the period 03.06.2022-03.07.2022. The management of the Dance Art sports dance club in Târgu Mureş agreed to conduct the research within the club premises.

Data Analyses

The results of the research were analyezed using the statistical program GraphPad and the Student T test (with $p>0.05$) was used for identifying the significance of the results.

It was compared the initial results of the VAS test with the final results in the control group and the experimental group, also the results of the Bosu ball unipodal test results in the control group and the experimental group and the difference between groups.

Table 1. Subjects from the control group

Subjects	Age	Sex
M.C.	12 years	M
C.T.	11 years	F
R.B.	13 years	F
A.C.	10 years	F
P.M.	16 years	M
D.D.	12 years	M
A.B.	13 years	M
I.H.	15 years	F
R.B.	11 years	M
S.D.	16 years	F

Table 2. Subjects from the experiment group

Subjects	Age	Sex
C.D.	15 years	F
R.P.	16 years	M
D.F.	15 years	F
C.F.	12 years	F
D.B.	12 years	F
D.S.	15 years	M
K.C.	11 years	F
D.H.	13 years	M
E.T.	10 years	M
A.S.	13 years	F

Table 3. The kinetic protocol was performed in order to recover the pathology of the flat feet

Exercise 1	*Exercise 2*
I.P.: seated on the chair with the soles parallel, and the cylindrical foam roller will be placed under the soles; T1: rolling the soles forward on the surface of the foam roller; T2: rolling the soles backwards on the surface of the foam roller; Dosage: 4 series of 12 repetitions.	I.P.: seated on the chair with the soles parallel to the ground, and a towel is placed under the fingers; T1: by pinching the toes, the towel will gradually gather under the sole; Dosage: perform this exercise 7 times with each lower limb.

Exercise 3 I.P.: sitting on a chair with the feet parallel to the ground; T1: dorsiflexion of the hallux (lifting the hallux off the ground); T2: slow and controlled return of the hallux to the ground, keeping the arch of the plantar arch in tone; Dosage: 4 series of 10 repetitions (the exercise is performed with both lower limbs simultaneously or with each lower limb individually).	*Exercise 4* I.P.: sitting on a chair with the feet parallel to the ground; T1: dorsiflexion of the phalanges (lifting the phalanges off the ground); T2: their return to the ground, slow and controlled by activating muscle tone, maintaining the arch of the plantar arch; Dosage: 4 series of 12 repetitions.
Exercise 5 I.P.: sitting on a chair with the feet parallel to the ground; T1: dorsiflexion of the hallux; T2: slow and controlled return of the hallux to the ground, keeping the arch of the plantar arch in tone; T3: dorsiflexion of fingers 2–5; T4: the slow and controlled return of fingers 2–5 on the ground, keeping the arch of the plantar arch in tone; Dosage: 4 series of 10 repetitions.	*Exercise 6* I.P.: sitting on the chair with the ankle of the right lower limb positioned on the left knee and around the leg of the right lower limb, an elastic band is attached with one of the ends, the other end being positioned under the sole of the left lower limb; T1: inversion of the right leg against the resistance of the elastic band, after which it relaxes to the initial position; Dosage: 3 series of 8 repetitions (same as with the other lower limb).
Exercise 7 I.P.: sitting on the mattress with an elastic pasted behind the soles, and its ends are caught in the hands; T1: active-passive dorsiflexion is performed by pulling the elastic band, resulting in the stretching of the calf muscles and the Achilles tendon with a 20-second hold; Dosage: 3 times every 20 seconds of maintenance.	*Exercise 8* I.P.: sitting on the mattress with an elastic band passed over the tips, and its ends are caught in the hands; T1: plantar flexion with stretching of the tips against the resistance of the elastic band; T2: plantar dorsiflexion; Dosage: 4 series of 10 repetitions.
Exercise 9 I.P.: orthostatic with feet apart below shoulder level, feet parallel;	*Exercise 10* I.P.: orthostatic with parallel feet positioned on the half-sole at the edge of the stepper;

T1: lift the plantar vault off the ground by inversion, then return to the initial position; Dosage: 4 series of 10 repetitions.	T1: lifting on top of the ankle joint; T2: lowering to the initial position; Dosage: 4 series of 10 repetitions.
Exercise 11	*Exercise 12*
I.P.: orthostatic on the right lower limb, the left lower limb is raised from the ground with the knee bent; T1: through eversion, the plantar vault is raised from the ground, maintaining unipodal balance, after which it relaxes; Dosage: 4 series of 8 repetitions (similarly, it is also performed with the other lower limb).	I.P.: orthostatic on the right lower limb, the left lower limb is raised from the ground with the knee bent; T1: maintaining the plantar arch in the correct anatomical position by activating the musculo-ligament tone of the foot (the weight is concentrated on the outer part of the sole); Dosage: 4 times for 30 seconds (similarly, it is also performed with the other lower limb).
Exercise 13	*Exercise 14*
I.P.: standing with the legs slightly apart below the level of the shoulders, and a pencil is placed horizontally on the ground between the two legs, with the ends positioned under the areas of the plantar arches; T1: rolling the sole from the heel to the toe without touching the pencil with the plantar arch; T2: rolling the sole from the tip to the heel without touching the pencil with the plantar arch; Dosage: 4 series of 10 repetitions.	I.P.: standing with legs slightly apart below shoulder level with or without a kettlebell; T1: slow squat, concentrating the weight on the outside of the soles, and the plantar arch is activated and does not touch the ground as much as possible; Dosage: 4 series of 8 repetitions.
Exercise 15	*Exercise 16*
I.P.: orthostatic with the legs slightly apart with an elastic ball positioned between the two ankles at the medial sub malleolar level; T1: rise on the toes, keeping the ball between the medial sub-malleolar parts of the foot; T2: catching the ball with the feet; T3: lowering to the ground with the heels, reaching the initial position; Dosage: 4 series of 8 repetitions.	I.P.: orthostatic with a pencil positioned on the ground; T1: the pencil is lifted from the ground using only the fingers and leg muscles, after which the pencil is placed back on the ground; Dosage: 5 times with each lower limb.

Exercise 17	*Exercise 18*
I.P.: orthostatic with the left lower limb positioned in front and the other behind with the soles on the ground, parallel to each other; T1: by bending the trunk forward and bending the left knee, the calf muscles and the Achilles tendon are stretched for 15 seconds; Dosage: this exercise is performed 3 times for 15 seconds/hold with both lower limbs.	I.P.: orthostatic with the legs slightly apart, the soles parallel, the plantar arch is activated, raised from the ground; T1: dorsiflexion of the hallux, with a return to the initial position; Dosage: 4 series of 10 repetitions.
Exercise 19	*Exercise 20*
I.P.: sitting on a mattress with an elastic band attached with one end to the foot of the right foot and the other end to a trellis; T1: inward circumduction of the right leg against the resistance of the elastic band; Dosage: 4 series of 8 repetitions.	I.P.: orthostatic; T1: slow walking with awareness of plantar arch activation; Dosage: 3 times for 3 minutes.

Table 4. The kinetic protocol performed in order to recover low back pain

Exercise 1	*Exercise 2*
I.P.: sitting on a mat with the lower limbs attached, with a medicine ball on the tibial area, and the hands are positioned on the ball; T1: flexion of the trunk on the thighs, rolling the arms on the ball, holding for 5 seconds, then returning to the initial position; Dosage: 4 series of 8 repetitions.	I.P.: sitting on a mat with the lower limbs spread out to the sides, with a medicine ball in front of the body, hands on the ball; T1: bending the trunk towards the ground, rolling the ball forward, after which it returns to the initial position; Dosage: 4 series of 8 repetitions.
Exercise 3	*Exercise 4*
I.P.: sitting on the mat with the thighs on the calves, the trunk fully flexed on the thighs, the upper limbs stretched forward on the ground; T1: placing the hands slightly to the left, without lifting the trunk from the thighs, the trunk is transferred to the left side,	I.P.: sitting on the mat with the left lower limb flexed and positioned slightly to the side of the body, and the right lower limb extended forward; T1: flexion of the trunk on the thigh of the right lower limb, without rotation of

generating a more intense stretch on the right side of the back, after which it returns to the IP T2: placing the hands slightly to the right, without lifting the trunk from the thighs, the trunk is transferred to the left side, generating a more intense stretch on the left side of the back, after which it returns to the IP Dosage: 3 series of 6 repetitions.	the trunk, with a 15-second hold, after which it returns to the initial position; Dosage: 3 series of 5 15-second holds (this exercise is performed analogously with the other lower limb).
Exercise 5	*Exercise 6*
I.P.: sitting on the mat with the left lower limb flexed and positioned slightly to the side of the body and the right lower limb extended forward; T1: trunk flexion on the thigh of the right lower limb with rotation so that the trunk is parallel to the wall, holding for 15 seconds, after which it returns to the initial position; Dosage: 3 series of 5 15-second holds (this exercise is performed analogously with the other lower limb).	I.P.: from orthostatic, we will perform a semi-squat, staying on the ground, the knees will be directed outwards, and the upper limbs will press the knees outwards with the elbows; T1: this position is maintained for 40 seconds; Dosage: 3 times for 40 seconds.
Exercise 7	*Exercise 8*
I.P.: quadrupedal; T1: extension of the right lower limb with that of the left upper limb, then returns to the initial position; T2: extension of the left lower limb with that of the right upper limb, then returns to the IP; Dosage: 4 series of 10 repetitions.	I.P.: quadrupedal; T1: flexion of the spine, resulting in its bending; T2: extension of the spine, resulting in its arching; Dosage: 4 series of 10 repetitions.
Exercise 9	*Exercise 10*
I.P.: supine position; T1: flexion of the right lower limb on the trunk, bringing the knee to the chest and holding for 10 seconds, after which it returns to the initial position;	I.P.: supine position; T1: bring the right knee to the chest; T2: the right knee is brought over the left lower limb and positioned on the ground, creating a twist of the trunk and maintaining this position;

T2: flexion of the left lower limb on the trunk, bringing the knee to the chest and holding for 10 seconds, after which it returns to the initial position; Dosage: 3 series of 8 repetitions.	Dosage: 3 series of 7 repetitions (analogously, it is also performed with the other lower limb).
Exercise 11	*Exercise 12*
I.P.: supine position; T1: by rolling the body backwards, pass the lower limbs over the trunk, above the head and maintain this position for 15 seconds; Dosage: 3 times.	I.P.: supine with the sole of the right lower limb on the ground, the other lower limb is positioned with the ankle on the right knee, grasp the hands behind the thigh of the right lower limb and pull it towards the body; T1: pull the right lower limb towards the body, then return to the initial position; Dosage: 3 series of 5 repetitions (similarly, it is also performed with the other lower limb)
Exercise 13	*Exercise 14*
I.P.: ventral decubitus with palms placed sub axillary, on the ground; T1: push the trunk off the ground without lifting the pelvis, resulting in an upward extension of the trunk with a 15-second hold, then return to the starting position; Dosage: 3 times.	I.P.: ventral decubitus with palms placed sub axillary, on the ground; T1: pushing the trunk off the ground, lifting the pelvis and sitting back on the calves with the thighs, holding for 15 seconds, then returning to the starting position Dosage: 5 times.
Exercise 15	*Exercise 16*
I.P.: orthostatic with the trunk bent at 90 degrees to the ground, hands on the trellis for support; T1: holding this position for 30 seconds (or more if possible), then relax; Dosage: 3 times.	I.P.: orthostatic; T1: total flexion of the trunk on the thighs, touching the ground with the hands, holding for 20 seconds; Dosage: 3 times.

Results

This research included 20 male and female subjects between the ages of 10 and 16. They were divided into two groups (the control and experimental groups, each comprising ten subjects).

The experimental group followed the two protocols proposed by us in order to recover the flat foot and post-exercise lumbago. The control group followed the protocol developed by Marius Militaru for the recovery of the flat foot and the protocol demonstrated by the therapist Josh Withney at the Palmetto Health-USC Medical Group institution for the recovery of post-exercise low back pain.

After performing the protocols for one month, the VAS score of the control group improved substantially, and there were even cases in which the post-exercise lumbar pain entirely improved in 3 of the ten subjects of the experimental group. In the case of the recovery of the flat foot, an improvement in the stability of the foot was observed, but the ligamentous laxity remained the same due to the continued practice of Latin dances with the specific technique.

Table 5. Results of the VAS score in the control group for low back pain

Subjects	Initial VAS score	Final VAS score
M.C.	7	3
C.T.	6	2
R.B.	6	3
A.C.	6	2
P.M.	5	3
D.D.	7	3
A.B.	6	2
I.H.	7	3
R.B.	7	3
S.D.	7	3

The significance T test was applied to discover if the results of the VAS score in the control group were significant. It was discovered that the difference between the initial and the final VAS score for the control group were statistically significant with a P value of 0.0001.

Table 6. VAS score results in the experimental group for low back pain

Subjects	Initial VAS score	Final VAS score
C.D.	6	2
R.P.	6	0
D.F.	7	1
C.F.	5	2
D.B.	6	1
D.S.	6	1
K.C.	6	0
D.H.	7	2
E.T.	5	0
A.S.	6	2

Applying the kinetic protocol for low back pain created by us shows a decrease in the final VAS score significantly better than the final VAS score of the control group, indicating a greater efficiency of our protocols to improve post-exercise low back pain in performance dancers.

The results of the initial VAS score and final VAS score in the experimental group was calculated with the T test. The results show that there are statistical significant improvements with a p value of 0.0001 between the VAS score of the experimental group at the initial and final test.

The final results of the VAS test between the experimental group and the control group were compared and was found a statistically significant difference with a p value of 0.0002.

Table 7. Results of Achilles tendon axis improvement in the control group in flatfoot pathology

Subjects	Deformation of the trend axis. Achillean, on initial visual inspection	Improvement in the final phase after performing the kinetic protocol
M.C.	YES	YES
C.T.	YES	NO
R.B.	YES	NO
A.C.	YES	YES
P.M.	YES	NO
D.D.	YES	NO
A.B.	YES	YES
I.H.	YES	NO
R.B.	YES	YES
S.D.	YES	NO

Table 8. The results of improvement of the axis of the Achilles tendon in the experimental group in the pathology of the flatfoot

Subjects	Deformation of the trend axis. Achillean on initial visual inspection	Improvement in the final phase after performing the kinetic procedure
C.D.	YES	YES
R.P.	YES	YES
D.F.	YES	YES
C.F.	YES	NO
D.B.	YES	NO
D.S.	YES	YES
K.C.	YES	YES
D.H.	YES	NO
E.T.	YES	NO
A.S.	YES	YES

Applying our protocol for the recovery of the flat foot on the experimental group, a 60% improvement in the axis of the Achilles tendon was observed compared to the control group where only 40% of the subjects had an improvement. At the same time, compared to the control group, the experimental group achieved a significant improvement in the stability of the ankle joint, an aspect highlighted by the final results of the single-foot Bosu test.

Table 9. Bosu ball unipodal test results in the control group

Subjects	Initial test on Bosu ball (sec)		The final test on Bosu ball (sec)	
	Left leg	Right leg	Left leg	Right leg
M.C.	8	12	11	14
C.T.	6	9	11	13
R.B.	5	7	9	11
A.C.	5	9	13	12
P.M.	7	11	10	13
D.D.	9	7	10	10
A.B.	10	9	14	12
I.H.	8	10	13	14
R.B.	6	7	11	13
S.D.	7	10	8	13

The significance T test was applied to discover if the results of the Bosu ball unipodal test in the control group for the initial and final test in the left leg was significant or not. It was discovered that the difference between the initial and the final results for the bosu ball unipodal test for the left leg was statistically significant with a p value of 0.0002.

Same test was performed for the right leg and also was found a statistically significant result with a p value of 0.0001.

The next comparison at the results of the bosu ball unipodal test at the control group was between the left leg and the right leg at the initial test. It was discovered that the difference between the initial testing results of the left leg and the right were statistically significant with a p value of 0.008384.

Last comparison at the bosu ball unipodal test at the control group was between the left leg and the right leg at the final test. The Student T-test showed that was statistically significant difference between the left leg and the right leg at the final testing, with a p value of 0.025699.

Table 8. Bosu ball unipodal test results in the experiment group

Subjects	Initial test on Bosu ball (sec)		The final test on Bosu ball (sec)	
	Left leg	Right leg	Left Leg	Right leg
C.D.	9	10	13	16
R.P.	7	8	12	15
D.F.	10	8	15	16
C.F.	5	6	11	10
D.B.	6	9	9	14
D.S.	6	7	10	10
K.C.	7	7	9	11
D.H.	6	8	10	13
E.T.	5	9	10	14
A.S.	6	8	8	11

The significance T test was applied to discover if the results of the Bosu ball unipodal test in the experimental group for the initial and final test in the left leg was significant or not. It was discovered that the difference between the initial and the final results for the bosu ball unipodal test for the left leg at the experimental group was statistically significant with a p value of 0.000082. Same test was performed for the right leg and also was found a statistically significant result with a p value of 0.0001.

The next comparison at the results of the bosu ball unipodal test at the experimental group was between the left leg and the right leg at the initial test. It was discovered that the difference between the initial testing results of the left leg and the right were statistically significant with a p value of 0.02747.

Last comparison at the bosu ball unipodal test at the experimental group was between the left leg and the right leg at the final test. The Student T-test showed that was statistically significant difference between the left leg and the right leg at the final testing, with a p value of 0.016858.

Discussions

One study indicates that medial foot collapse during gait is more prevalent in athletes with high generalized joint laxity than in athletes with low generalized joint laxity (Foss et al., 2009). Ferrari and Watkinson also chronicled related discoveries, mentioning that the centre of strain path was more median in ladies than in men, who show beyond doubt a centrally positioned centre of

pressure trajectory. They found that thanks to this median path, the leading metatarsal head was packed more in ladies than in men (Ferrari & Watkinson, 2005). Relating these aspects to our research, we discover the similarity between these studies and the current research that highlights an increased ligamentous laxity in female subjects due to the execution technique of the steps in Latin dances like Samba, Cha Cha, Rumba, Paso Doble and Jive.

Ballet is very similar to ballroom dancing in terms of foot technique, except that ballerinas dance on tiptoe or half-sole, and ballroom dancers use the entire sole through progressive toe-half-sole-heel contact in Latin dances like Samba, Cha Cha, Rumba, Paso Doble and Jive and the natural toe-to-heel roll in standard dances like Lent Waltz, Tango, Viennese Waltz, Slow Fox and Quick Step.

Li et al. state that external rotation, especially at the ankle joint, is essential for dancers to reach an extreme position in ballet. Limiting the ankle's range of motion can cause the foot to pronate (tilt inward) and cause the foot to lose medial arch support. If the stability provided by the midfoot begins to give or decrease, the dancer will compensate to maintain the centre of mass (Li et al., 2022). This element is also valid in sports dance, where the aesthetics of the foot technique is essential.

Applying the protocol created by us for the pathology of the flatfoot, we obtained an improvement of the plantar arch in the case of all subjects, an aspect proven by the improvement of the planograms on paper, where the reduction of the plantar impression on the medial side of the foot was observed in all subjects of the experimental group. Compared to the standard protocol applied to the control group, we obtained by applying our protocol an improvement of the Achilles tendon line in orthostatic in 9 out of 10 subjects, while applying the standard protocol only in 7 out of 10 subjects was observed. Laxity of ligaments and joint capsules can lead to disruption of joint stability and put dancers at risk of injury (Drezewska et al., 2012; Drezewska & Sliwinski, 2013).

LBP (low back pain) in CB dancers is overdue to the cumulative effects over years of suboptimal motor control, such as impoverished positional straightness, absence of coordination or inaccurate technique implementations (Gamboa et al., 2008; Roussel et al., 2009; Roussel et al., 2012), together with muscle imbalances (Gamboa et al., 2008; Steinberg et al., 2011), hypermobility or muscle tension (Gamboa et al., 2008; Roussel et al., 2009; Steinberg et al., 2011), maximal use of the lower limbs (Neguș et al., 2005) and excessive repetitive movements in non-physiological positions (Capel et al., 2009; Nilson et al., 1993; Gottschlich & Young, 2011).

Our study similarly highlights these aspects, demonstrating the importance of knowing the optimal technique for executing positions and movements during the dance, correct coordination and achieving a balance in the intensity of muscle tone.

Another study argues that the intrinsic plantar foot muscles within the active and neural subsystems play a critical role in the central foot system as local stabilizers and direct sensors of foot deformation (McKeon et al., 2015). Therefore, it is imperative to strengthen the muscular-ligamentous structures of the foot, especially the plantar ones, which are essential in maintaining the natural plantar arch of the foot and its stability together with the ankle joint. Relating the idea of this study to our research, we reach the same conclusion: the importance of developing the plantar muscular-ligament force through specific kinetic exercises that increase plantar stability and improve the flat foot, reconstructing its plantar arch.

These protocols can also be applied as prophylaxis, not only for recovery but to ensure effective prevention; it is necessary to train athletes about these two conditions and apply a separate protocol of exercises aimed at strengthening the abdominal muscles (to prevent low back pain) and the joint ankle (to prevent flatfoot). It is also essential that the athletes know the correct execution of the exercises and that the two protocols are applied under a specialist's supervision.

Conclusions

In conclusion, applying the kinetic protocol to recover low back pain after training brought a positive result in relieving low back pain, proving to be more beneficial than the standardized protocol for dancers, especially for female subjects.

Regarding the application of the kinetic protocol was found statistically significant differences between the initial and final evaluation of pain with the VAS scale at both control group and experimental group.

At the Bosu ball unipodal test results were discovered statistically significant improvments also in the control group and the experimental group at both left leg and right leg.

The kinetic protocol was efficient in reducing back pain and also some good results were observed in reducing the flat foot deficiency.

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