Republic of Albania

Sports University of Tirana

Faculty of Movement Sciences

Third Level of Doctoral Studies

Doctoral Thesis Summary

Field of Study:

"PHYSIOLOGY APPLIED IN SPORT"

TOPIC:

"EFFECTS OF FUNCTIONAL EXERCISES ON POSTURE AND EQUILIBRIUM IN 19-22 YEARS OLD SUBJECTS"

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Abstract

Posture is the placement and maintenance of body segments in several positions, such as standing, stretching, or sitting. It is thought that there is an optimal position for each given assignment (Gracovetsky., 1988). Significant deviations from optimal posture are said to be aesthetically unpleasant and negatively affecting muscle efficiency, making individuals more likely to be affected by pathological or neurological conditions (Novak & Mackinnon, 1997, as quoted by Hrysomallix & Goodman, 2001). The first objective of this study was to find out posture and balance problems among 19-22 year olds. The second objective of this study was to improve posture and equilibrium through a functional exercise-training program compared to a traditional exercise training exercise program. The third objective of this study was to find a link between the possible improvements of the posture in relation to the balance.

The subjects chosen to be part of this study were students of the "Bachelor" level of the 3rd course, "Faculty of Physical Activity and Recreation" part of "Tirana Sports University". In total, the evaluation measurements were performed in 90 subjects where they were selected and only 45 were selected to become part of this study, of which 21 F and 24 M were part of this study. Upon completion of the general selection, the subjects were randomly divided into 2 groups: Group 1, Intervention group, which would perform a program that included functional training and core training exercises. Group 2, Control group, who would conduct a exercise program focusing on traditional fitness exercises (basic exercise training). The subjects were also underwent posture measurements, which were carried out using a computer program (Posture Screen Mobile) which used 4 digital photographs made in 4 different plane of the body in the stnading right position: After completion of the posture measurements subjects were also subjected to balancing tests carried out through the Leonardo Platform (Leonardo Mechanography). BT (Balance Test) / Equilibrium Test / Expression of balance and coordination.

The tests carried out consisted of a group of 4 tests:

- Romberg standing, open eyes (Rom EO) (gloved feet, hands before)
- Romberg standing, eyes closed (Rom EC) (hinged legs, hands before)
- Tangent standing, open eyes (Tan EO) (tangent feet, hands before)
- Tangent standing, closed eyes (Tan EC) (tangent legs, hands in front)

The exercise program of the traditional fitness-training group consisted of: 3 weekly frequencies; 2 main muscles groups for each frequency. The weekly program of functional exercises consisted of: Core Training for Core Muscle and Functional Exercises: 30 min. The ANOVA results with 2 repeat measurements with the degree of freedom corrected with Greenhouse-Geisser (F (1, 55) = 21, 624, p <0,0005) showed a statistically significant difference between the two measurements (Sig. <0.0005) leading us to the conclusion that the hypothesis was accepted and the training plans applied were effective for improving the posture. Based on the first measurement results, was noticed that in general the selected subjects did not have significant problems with regard to postural angles. Following the follow-up of the training plan in both groups, an improvement of the posture was noted, respectively with 3.46 in the experimental group and with 1.57 in the control group. The CoF (Center of Force / Center of Force) values go up to point 0 and consequently the signs that appear in the elliptical areas are more concentrated and smaller in the second measurement. Based on the results of this study compared to the results of similar studies, we can say that postural issues remain unresolved. Improvement of all angles speaks out for a general posture improvement resulting from adaptive abnormal muscle antagonist cuts in relation to their strong antagonists. We think that more intrusive studies should be carried out over a longer period of time with similar programs of younger age groups where the full ossification has not yet taken place. It would be very important to build a national plan and system throughout the education system and not just to control and evaluate posture problems from early childhood, where it is essential to include specialists in physical education.

Key words: *Functional exercises, core training, posture, equilibrium*

Introduction

General Prescription, Literature Review

Posture is the placement and maintenance of body segments in several positions, such as standing, stretching, or sitting. It is thought that there is an optimal position for each given assignment (Gracovetsky., 1988). Significant deviations from optimal posture are said to be aesthetically unpleasant and negatively affecting muscle efficiency, making individuals more likely to be affected by pathological or neurological conditions (Novak & Mackinnon. 1997, Hrysomallix & Goodman. 2001).

It has been proven that if the body segments are kept out of the straight standing line for long periods of time, the muscles will "relax" in a shortened or prolonged position for a long time (Bloomfield, 1994, as quoted by Hrysomallix & Goodman, 2001). Over time this can lead to cuts and adaptive extensions (Novak & Mackinnon, 1997; Hrysomallix & Goodman, 2001). Muscles subject to appropriate cuts tend to and strengthen, placing the antagonist muscle in a prolonged and weakened position (Kendal, et al., 1993). These changes in the length of the muscle, in silent condition, can affect the orientation. It has also been seen that customized shortening of the muscle may occur as a result of overuse of the muscle, particularly in shortened series of movements (Janda V., 1993; Kelly, E.D., 1949). This phenomenon is believed to cause postural injuries. Exercises are promoted as tools for correcting postural deviations as a result of the above two causes. It is said that the exercise can correct straight-forward deviations such as lumbar lordosis, scoliosis, kyphosis and shifted scapula (Reiter & Cato., 1970; Wells, 1963; Zatsiorsky, 1995).

This may be the result of improved muscle equilibrium. Before each discussion that can be made on issues pertaining to residence, we must first refer to the two main factors. The first of these is a collection of posture muscles. The muscles involved in maintaining the residence are largely dependent on the person's activity or position, but we can make generalizations of which muscles are the main muscles of the posture. Postural standing muscles are usually thought to be abdominal muscle groups and back extensions (Kelly, 1949; Hrysomallis & Goodman, 2001).

However, this is a rather limited description, as the muscles in the foot, the calf group, the front muscles of the thigh, the pelvic back muscles and the muscles between the shoulders are thought to be postural muscles (Kelly., 1949). This assertion is supported by Hughes and colleagues, 2000, who showed that plantar flexoral muscles, knee flexors, pelvic extensions, and shoulder flexors were important postural muscles. Another study also found that soleus muscles, medial gastrocnemius, and anterior tibialis play an important role in general attitudes and balances in particular (Bloem et al., 2002). Plantar flexors and dorsiflexors are also seen as important muscles of posture control in Yaggie and McGregor's research. (2002). The second important factor to be considered is optimal posture. At a time when much is written about the importance of optimal posture (Gracovetsky, 1988, Phelps & Kiphuth, 1932) and how to develop it (Wells, 1963), there is very little scientific research on what the features of optimal posture are.

Wells., 1963, suggests the following criteria for optimal stay:

1. The whole body weight focuses entirely on both feet, or slightly ahead, but never behind.
2. The larger weight-carrying segments of the body are positioned in a single straight line, either vertical or slightly inclined, by the cords.
3. The pelena is completely focused on both feet and under the trunk, providing sustained support for the latter.
4. The chestnut is slightly raised but raising is not obligatory.
5. The head is right with the vertical profile and the beard on the level.
6. Legs point forward or slightly behind.
7. Crawls, both from the front and from the back are right
8. All posture is held without any visible tension or hardening.

In a more accurate description, but also without much scientific support, Reiter & Cato., 1970, describe the optimum attitude, where equal parts of the bust lie before and behind the sagital plan with little or no backbone curves from the back angle. These recommendations have two main limitations. The first of these limitations is that none of them is supported by searches. The second limitation is that the suggestions apply only to standing. It is said that the optimal posture is that specific in relation to the task (Gracovetsky, 1988), and as such these recommendations can not be adapted to the dynamic posture. However, Reiter & Cato., 1970, noted that the standing posture of an individual can provide clues to his dynamic posture. Gracovetsky., 1988, developed a postural model without the limitations of the above suggestions. This mathematical model can be applied in all forms of residence (sitting, walking, walking, etc.). This model defines the optimal posture, the one in which the total stress is minimized over each articulation and the stress over all the muscles equates. The components that form the total stress of articulations in this model are distributed stress, suppression, ligament tension and muscle activity. Equalizing these forces means that system stresses are balanced so that the sum of all the stresses of the wrists is minimized. Regardless of which of these patterns or suggestions are followed, there seems to be an essential understanding that many individuals do not often fit in the optimum posture. This may be due to either muscular or nerve issues.

In the above material we have tried to give a clear picture of the issues we have dealt with in this study but also similar and related issues because we thought that their explanation and discussion would make clear the evidence and specification of the main objectives of this study. So taking into account all the importance and sensitivity of the posture, equilibrium and its improvement through present-day alternative programs and exercises we thought it would be very interesting to develop exactly this study.

Hypothesis:

- We think that to improve posture and balance among young people aged 19-22, intervention through functional exercises is more effective than traditional exercise training (strength exercises).

Objectives:

Objective 1: The first objective of this study was to find out the problems of posture and equilibrium among 19-22 year olds.

Objective 2: The second objective of this study was to improve posture and balance through a program of functional exercise exercises compared to a traditional exercise training exercise program.

Objective 3: The third objective of this study was to identify a link between the possible improvement of the posture in relation to balance.

Material and Methods

The subjects chosen to be part of this study were students of "Bachelor" of the 3rd course, "Faculty of Physical Activity and Recreation" part of "Sports University of Tirana". In total, the evaluation measurements were performed in 90 subjects and only 45 were selected to become part of this study, of which 21 females and 24 males.

Criteria for selecting subjects

- Subjects should be aged 19-22 years
- Subjects of both sexes (Male & Female)
- Subjects should be able to accomplish the training workloads

Exclusion criteria in the selection of subjects

- Subjects should not have musculoskeletal trauma or various injuries
- Subjects should not have had any illness or had undergone any recent surgical interventions.

After completing the general selection, the subjects were randomly divided into 2 groups: 1. Group 1, Intervention group, which would perform a program involving functional training and core body training, 2. Group 2, the control group who would conduct a program of exercises focusing on traditional fitness exercises (basic exercise exercises).

Anthropometric measurements

All subjects selected were subjected to anthropometric measurements; Weight & Length and Body Mass Index (BMI) (see results) before performing posture and balance measurements. All tests were carried out by the biomechanics laboratory part of the UST, from the same staff and the same measuring devices.

- The scales used to weigh the weight was the ishte modeli “Health o meter” Professional Model: 500KL
- The scales were equipped with a static meter to measure the length.
- For the calculation of BMI the formula was used: BMI = Weight (kg) / Length in m^2 x Length in m^2

The subjects were also underwent posture measurements, which were carried out using a computer program (Posture Screen Mobile) which used 4 digital photographs made in 4 different plane of the body in the standing right position:

1- Anterior view

2- Right lateral view

3- Posterior view

4- Left lateral view

After completion of the posture measurements subjects were also subjected to balancing tests carried out through the Leonardo Platform (Leonardo Mechanography). BT (Balance Test) / Equilibrium Test / Expression of balance and coordination.

The tests carried out consisted of a group of 4 tests:

- Romberg standing, open eyes (Rom EO) (hinged legs, hands forward)
- Romberg standing, eyes closed (Rom EC) (hinged legs, hands forward)
- Tangent standing, open eyes (Tan EO) (tangent feet, hands forward)
- Tangent standing, closed eyes (Tan EC) (tangent legs, hands forward)

Results

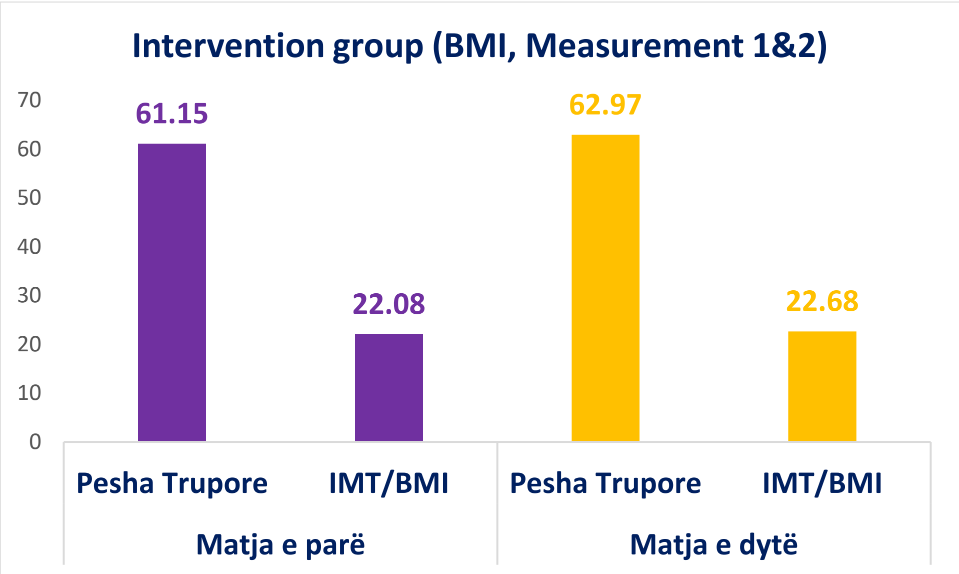
Participants in the study

Anthropometric measurements

Table 1. *Intervention group performing Functional Workout (First and Second Measurement)*

Nr	Subject ID	Age years	First measurement			Second measurement	
			Body weight	Height (m)	MI	Body weight	BMI
1	ID L001120	20	49.5	1.58	19.82	49.2	19.69
2	ID L001097	20	44.5	1.55	18.52	43.4	18.08
3	ID L001094	20	63.8	1.69	22.33	66	23.11
4	ID L001230	20	63.6	1.69	22.23	64.8	22.66
5	ID L001108	21	68.9	1.77	23.07	72.3	22.03
6	ID L000915	21	70.1	1.61	27.06	76.1	29.36
7	ID L001179	20	57.3	1.62	21.83	59.5	22.67
8	ID L001174	20	65.7	1.67	23.51	65.7	23.57
9	ID L001176	20	75.7	1.64	28.66	80.1	29.79
10	ID L001114	20	50.5	1.59	20.52	51.4	20.32
11	ID L001225	20	65.4	1.65	24.03	66	24.23
12	ID L001104	20	80.2	1.85	23.43	82.7	24.16
13	ID L001109	20	48	1.65	17.62	51.2	18.78
14	ID L001228	21	70.3	1.74	23.22	70.1	23.16
15	ID L001175	20	68.6	1.77	21.90	70.1	22.40
16	ID L000824	20	57.7	1.67	20.03	59.2	20.61
17	ID L000873	20	53.8	1.55	22.39	54.6	22.73
18	ID L001124	20	52.9	1.60	20.66	56.1	21.90
19	ID L000916	20	64.5	1.63	24.27	66.4	24.99
20	ID L000928	19	62.5	1.73	20.88	68.1	22.76
21	ID L001229	21	62.8	1.79	19.60	65.2	20.34

22	ID L001122	21	57.8	1.64	21.47	58.1	21.60
23	ID L001183	23	43.2	1.63	16.28	46.3	17.43
24	ID L001226	20	61.2	1.61	23.61	63.2	24.39
25	ID L001193	21	74.1	1.70	25.39	76.9	26.62
26	ID L001117	20	74.1	1.70	24.40	78.1	27
27	ID L000825	19	52.2	1.70	18.28	53.6	18.53
28	ID L001117	25	59.4	1.66	21.09	60.2	21.86
29	ID L001185	20	60.7	1.58	25.22	60.7	24.30
30	ID L001110	19	52.6	1.58	20.92	49.8	20.93
31	ID L000877	19	72.6	1.75	24.52	77.5	25.29
32	ID L001098	19	52.7	1.60	20.04	52.7	20.57
Mesatarja		**20.28**	**61.15**	**1.66**	**22.08**	**62.97**	**22.68**

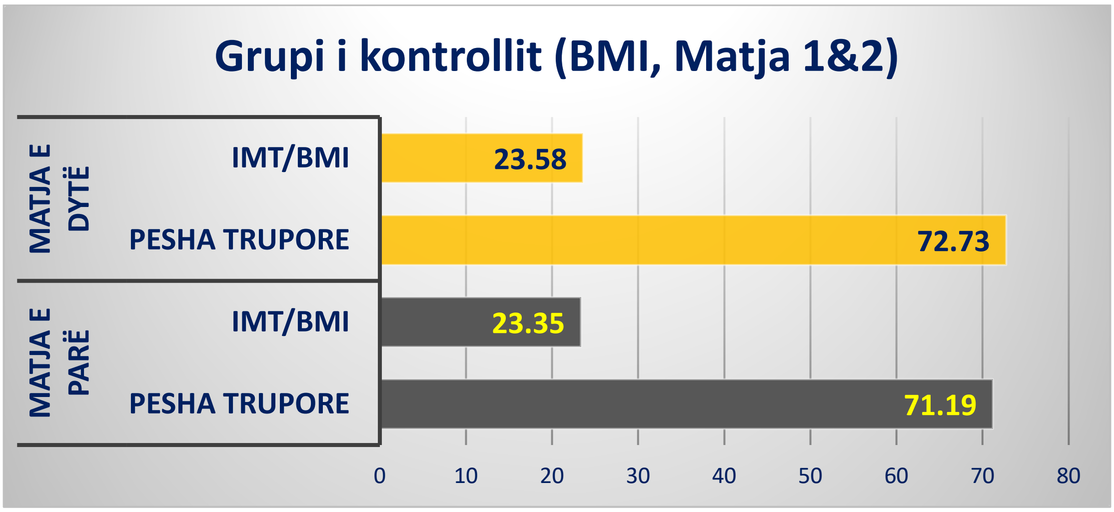


Graph 1. *Intervention grou; BMI, First and second measurement)*

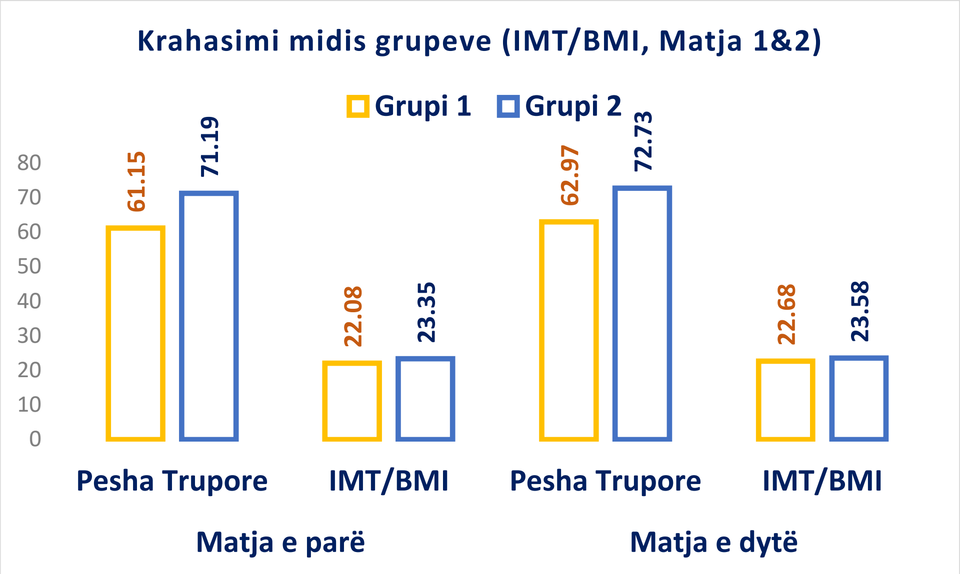
Table 2. *Control group traditiona fitness training (First and Second Measurement)*

Nr	Subject ID	Age	First measurement			Second measurement	
			Body weight	Height (m)	BMI	Body weight	BMI

1	ID L001096	21	80.9	1.78	25.52	87.1	27.50
2	ID L000878	21	68.2	1.77	21.91	71.3	22.76
3	ID L001102	23	62.6	1.77	20.46	63.2	20.18
4	ID L000880	20	84.2	1.80	27.07	86	26
5	ID L001107	21	77.4	1.78	24.22	80.2	25.31
6	ID L001106	20	49.3	1.54	20.63	49.5	20.87
7	ID L000823	20	69.7	1.71	23.16	70.6	24.15
8	ID L001118	21	52.9	1.65	20.19	53.3	19.58
9	ID L000913	20	72.2	1.84	21.17	74.7	22.04
10	ID L000188	20	70.5	1.78	22.38	67.6	21.34
11	ID L000876	19	73.2	1.76	23.91	76.3	24.64
12	ID L001186	20	77.5	1.54	32.14	76.9	32.42
13	ID L001111	20	86.9	1.58	20.82	88.9	19.83
Mesatarja		**20.46**	**71.19**	**1.71**	**23.35**	**72.73**	**23.58**

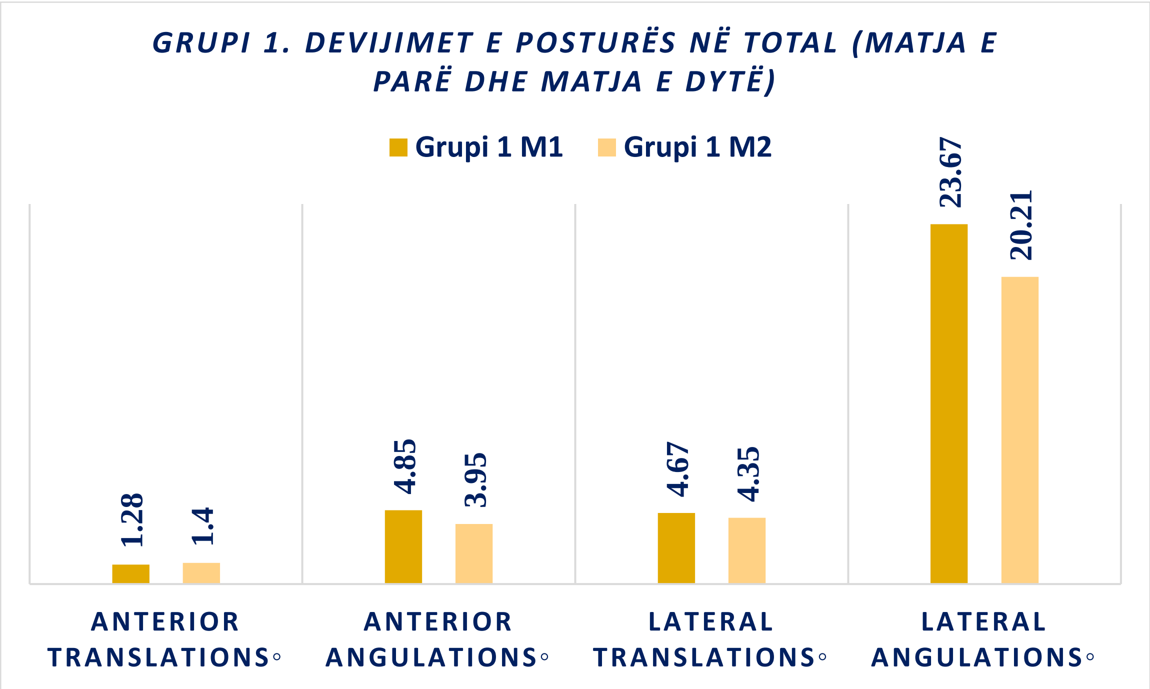


Grafiku 2. *Control group; BMI, (first and second measurement)*

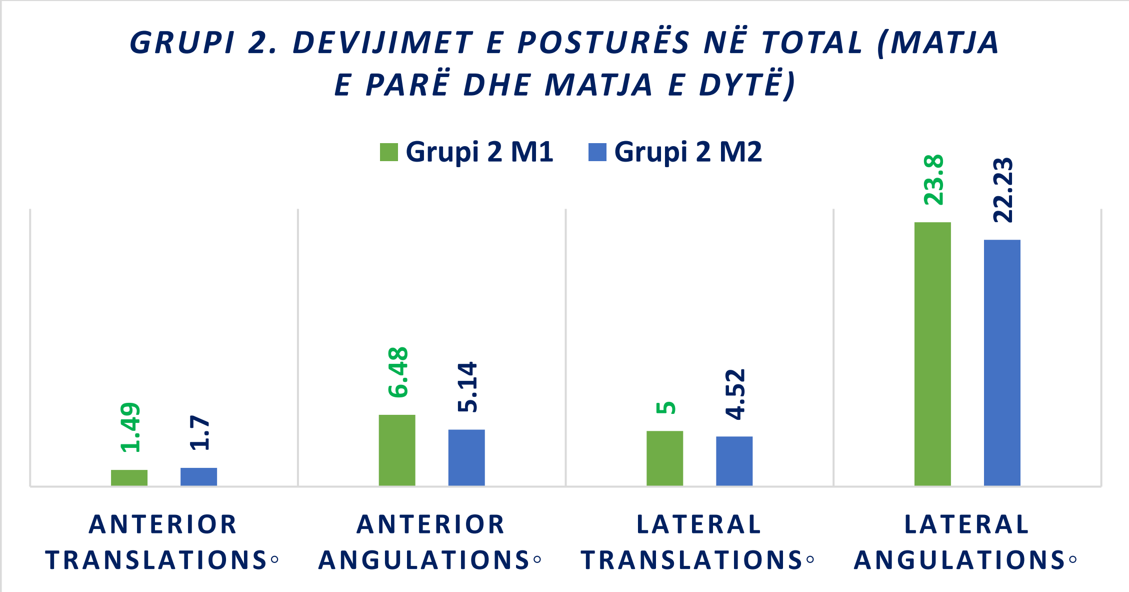


Grafiku 3. *Comparison between both groupsve; BMI, (first and second measurement)*

Posture results



Graph 4. ***Group 1. Pos****ture displacements total (First and second measuremnt)*



Graph 5. ***Group 2. Po****sture displacements total (First and second measuremnt)*

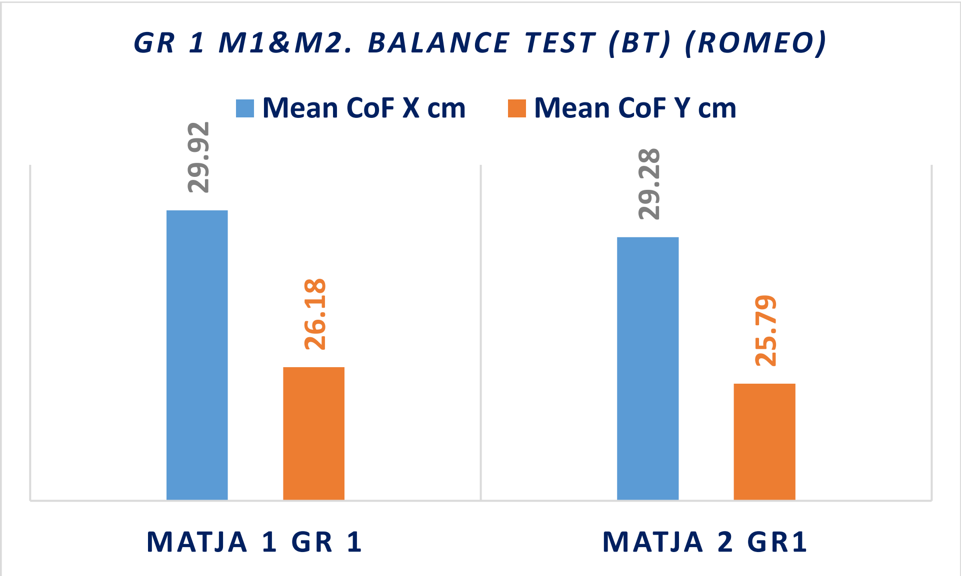
The ANOVA results with 2 repeat measurements with the degree of freedom corrected with Greenhouse-Geisser (F (1, 55) = 21,624, p <0,0005) showed a statistically significant difference between the two measurements (Sig. <0.0005) leading us to the conclusion that the hypothesis was accepted and the training plans applied were effective for improving the posture. The ANOVA analysis results with 2 repeated measurements showed a statistically significant difference between the averages of the "shifted average posture" variable.

We conclude that the results of repeated measurements of ANOVA showed that Training with the "Functional Workout" training plan was effective in improving the posture while an efficient improvement (statistically significant) was observed in the experimental group compared to the control group.

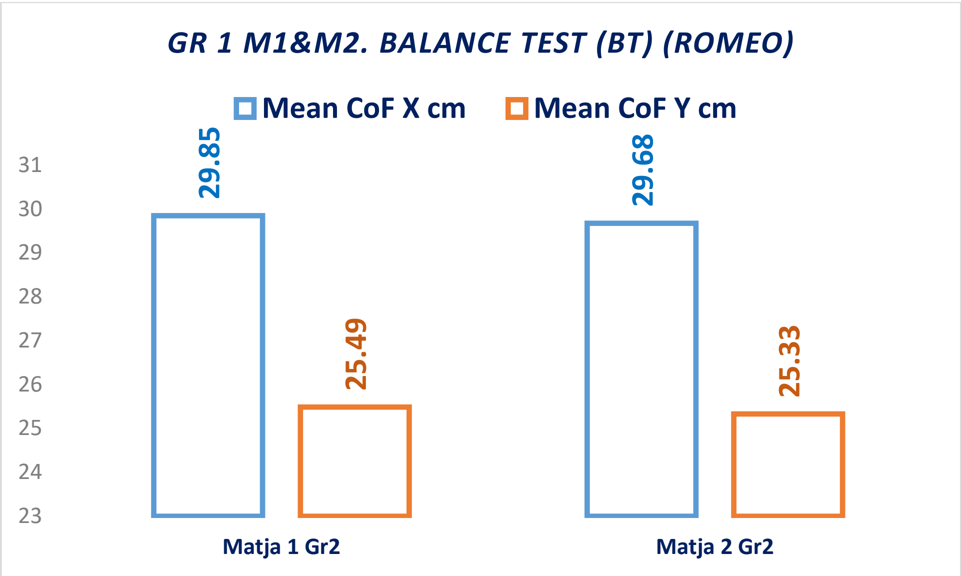
Results of equilibrium measurements

Leonardo GRFP Mechanography Measurement Report

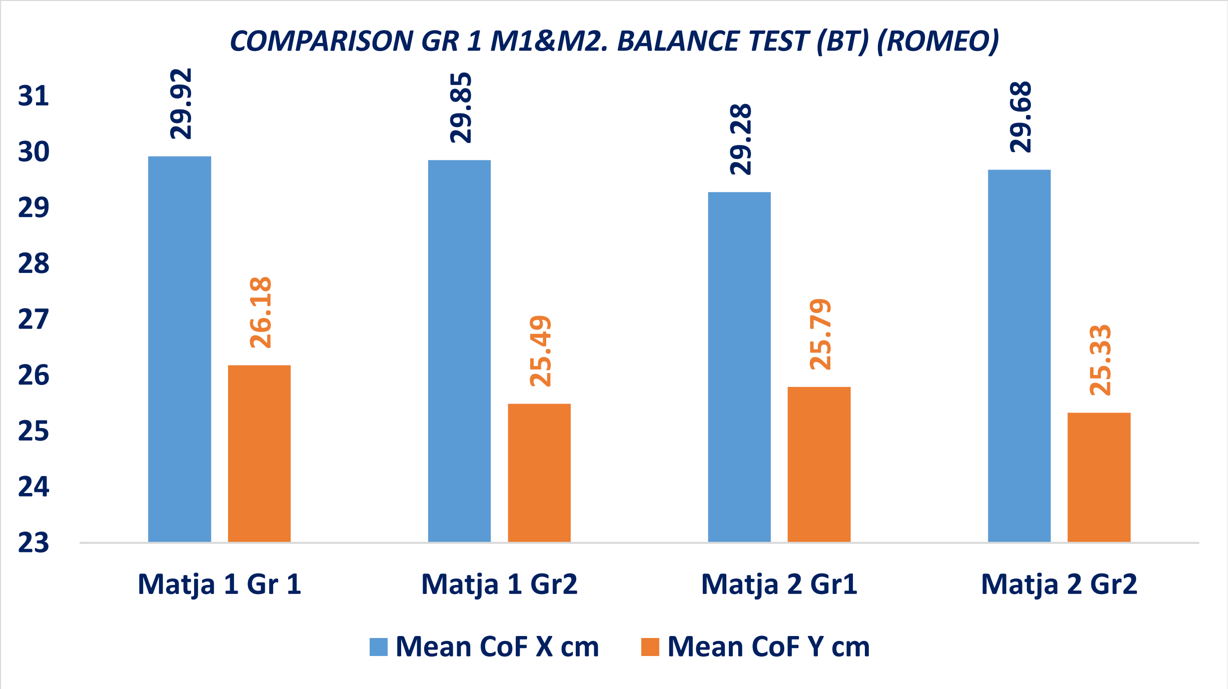
Measurement results of the Romberg Stand, eyes open (Rom EO) (hinged legs, hands before) for group 1 (intervention group) and group 2 (control group).



Graph 17. *Gr 1 M1&M2. Balance Test (BT) (RomEO). Analysis Results, Balance Data*

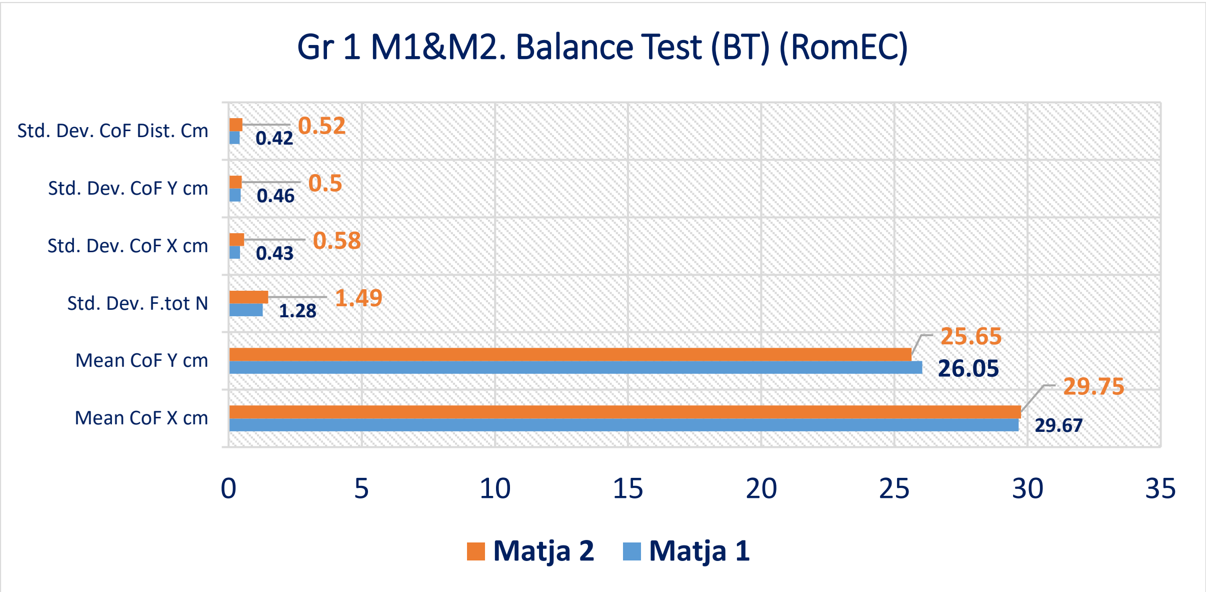


Graph18. *Gr 2 M1&M2. Balance Test (BT) (RomEO). Analysis Results, Balance Data*

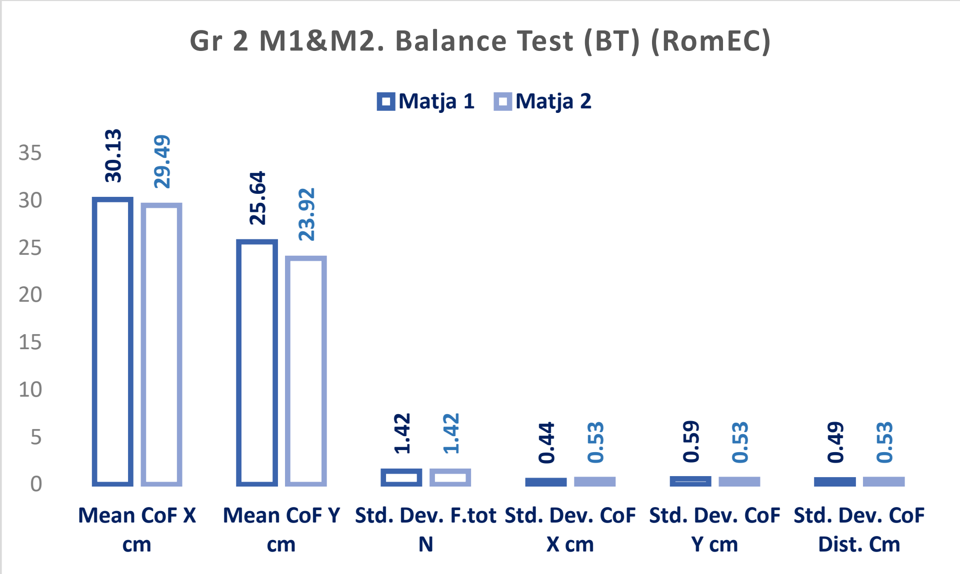


Graph 19. *Comparison Gr 2 M1&M2. Balance Test (BT) (RomEO). Analysis Results, Balance Data*

Results of the measurements of the Romberg Stand, closed eyes (Rom EC) (hinged legs, hands before), for group 1 (intervention group) and the second group (control group).

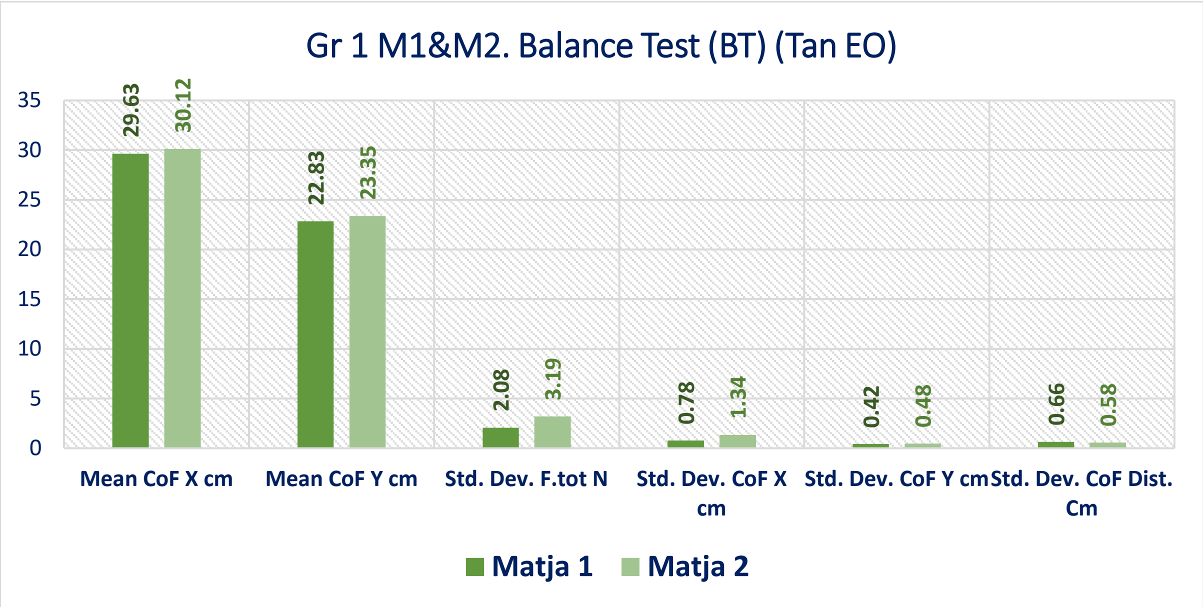


Grafiku 20. *Gr 1 M1&M2. Balance Test (BT) (RomEC). Analysis Results, Balance Data*

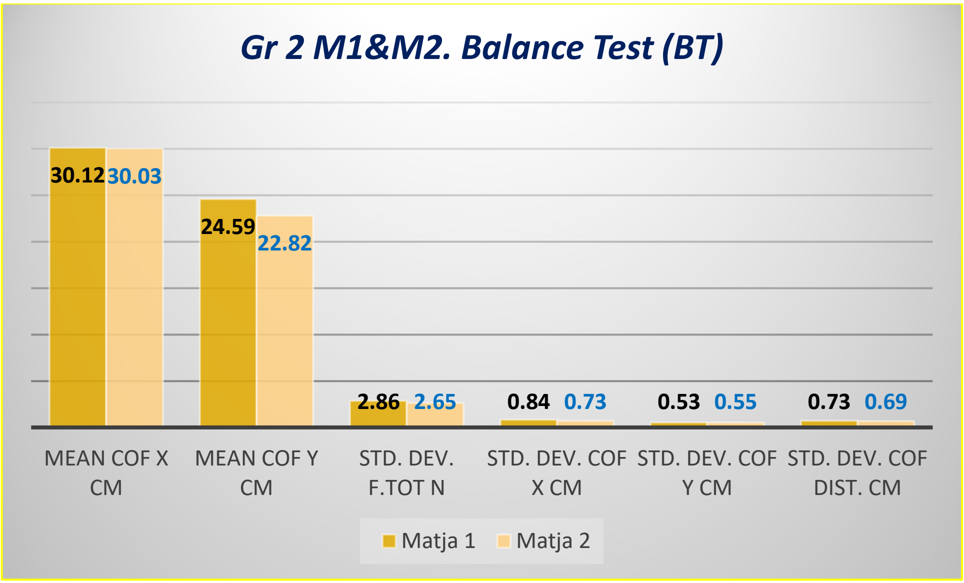


Grapf 21. *Gr 2 M1&M2. Balance Test (BT) (RomEC). Analysis Results, Balance Data*

Tangent Attitude Measurements, Eyesight (Tan EO) (tangent feet, hands before), for group 1 (intervention group) and the second group (control group).

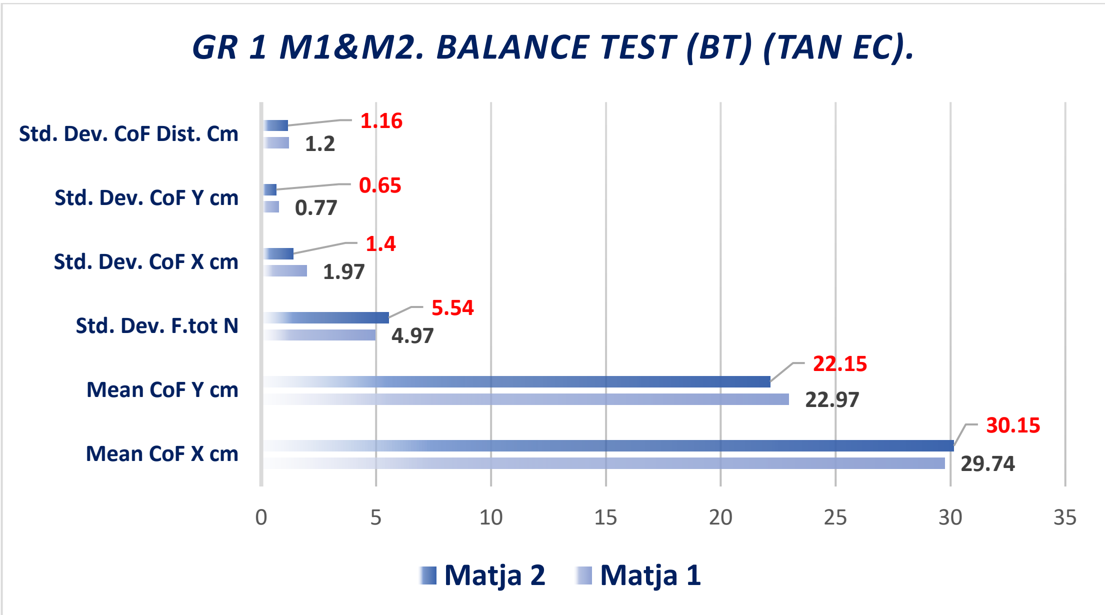


Graph 22. *Gr 1 M1&M2. Balance Test (BT) (Tan EO). Analysis Results, Balance Data*

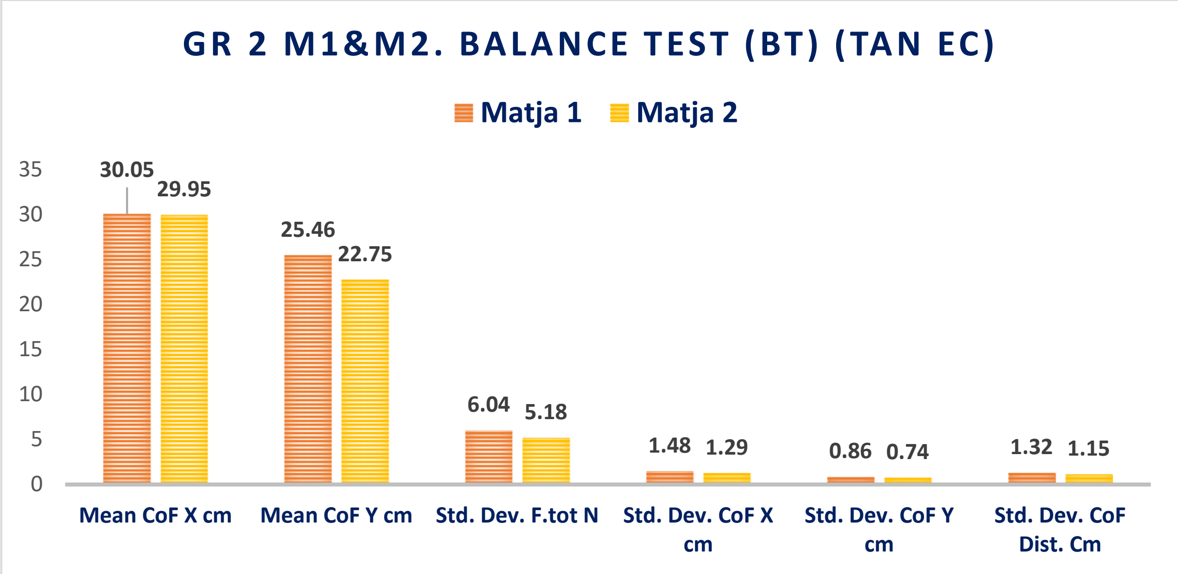


Graph 22. *Gr 2 M1&M2. Balance Test (BT) (Tan EO). Analysis Results, Balance Data*

Tangent Standards Measurement Results, Tan eyes (Tan EC) (tangent legs, hands before), for group 1 (intervention group) and group 2 (control group).



Graph 23. *Gr 1 M1&M2. Balance Test (BT) (Tan EC). Analysis Results, Balance Data*



Graph 24. *Gr 2 M1&M2. Balance Test (BT) (Tan EC). Analysis Results, Balance Data*

Discussion

In this study, selected subjects who underwent training programs noted an improvement in general posture because the intervention did not focus on specific parts of the body as in the case of any problem in the vertebral column (eg, scoliosis of type C or S, lordose or fox etc). These problems were evidenced but in light forms, because subjects do not come from sedentary lifestyles as they are students of Sports University of Tirana.

The problems encountered during the test of the posture were varied and diverse in both men and women. These problems were of musculoskeletal nature challenged by incorrect behavior or attitudes during life.

Regarding the first objective of the study, which was to identify the position and problems of posture and equilibrium among young people 19-22, based on the first measurement results, it was noticed that in general the subjects selected had no significant problems it belongs to the postural angles, even among them, in certain parts of the body, they had angles almost equal to the postural mathematical standard (angle 0˚) (see the first measurement results for both groups).

Equilibrium results Objective 2: The second objective of this study was to improve posture and balance through a program of functional exercise exercises compared to a traditional exercise training exercise program. The idea of this subject was born due to the great difference in functional training in relation to traditional fitness.

Functional exercise embraces muscle training through their all-inclusivity while the 3D fitness (traditional) trainer muscles or group-specific muscles. For this reason, training the body with multi-axis multi-plane exercises makes it possible to train weak muscles in relation to their symmetrical muscles.

Also possible is the muscle training that represents the kinetic chains (very large muscular synergy). In the case of traditional exercise only a few exercises train muscular synergy such as the Deadlift exercise case.

Exercising outside axes and out of plans, it is possible to train core muscles that play an essential role in postural issues. These muscles are exactly responsible for maintaining the spine and for the proper functioning of the entire skeletal musculoskeletal system (we can not have good results if we only group large muscle mass without making a good connection with the core muscles). Different postural problems like; skolioza, lordoza and kifoza occur due to staying for a long time in a wrong position as p. eg, keeping heavy weight bags on one side, rapid growth of the skeleton in relation to overall growth, job position, a specific job and some types of sports where only one of the limbs is used (tennis, ping-pong , hand wrestling, etc).

All these issues are related to the skeletal musculature system and muscle in particular.
In most cases these problems are related to weak muscles in one side of the vertebral column and consequently prolonged and with solid and strong muscles of the other (shortened) arm that tend to pull from their arm the vertebral column. This happens not only sideways but also front-back and rotating.
Based on the results of the study, at the end of the second measurement, which was conducted following the follow-up of the training plan in both groups, an improvement of the posture was noted, respectively with 3.46 ° in the experimental group and with 1.57 ° in the group control. As a result of this result we can say that through functional exercise we can prevent the further degradation of various posture problems, maintain and improve it in general compared to traditional fitness.

The reference point for the column angle estimation is the Cobb method of assessment (see Methodology). So referring to Objective 2, which was to improve posture and balance through a program of functional exercise exercises compared to a traditional exercise training exercise program.

Objective 3: The third objective of this study was to identify a link between the possible improvement of the posture in relation to the balance.

The results from the second measurement of the intervention and control group showed that the equilibrium was improved more to the group trained with the functional exercise, compared with the group trained in traditional fitness. Therefore based on these results we can say that there is a link between improving the posture and improving equilibrium.

Consequently, knowing that a good post office spends less energy than a poor posture, we realize that a better balance also requires less energy expenditure. This fact was understood by the elliptical shape that emerges in the graph shown in the report that emerges from Leonard's platform. The CoF (Center of Force / Force Center) values go up to point 0 and for and consequently the signs that appear in the elliptical areas are more concentrated and smaller.

Conclusions and recommendations

Based on the results of this study compared with the results of similar studies, we can say that postural issues remain unresolved. Improvement of all angles speaks for a general posture improvement resulting from adaptive abnormal muscle antagonist cuts in relation to their strong antagonists.

Regarding the first objective of the study, which was to identify the situation and problematic of posture and equilibrium among young people 19-22 years old, and after the results were reviewed for each of the data obtained from the tests we noticed that we faced with outstanding problems both in the posture and in the balance.

Even subjects who had problems were within the angle considered to be <10˚ angle (normal posture) and 10˚-20˚ (light scoliosis) according to Coob's standard for scoliosis, and 5˚-10˚ (normal posture), 10˚-20˚ (light lordosis and kyphosis) according to Meija for the kyphosis and Tuzun for lordosis and were not classified as individuals who had serious problems or heavy deviations of the column.

Going to the second objective of this study which was, improving posture and balance through a functional exercise training program compared to a traditional fitness training exercise program, we can say that a 3.46˚ improvement in the experimental group in relation to the angles generated by the measurements is a good improvement considering the short 12-week training program.

We can not say that this improvement can be continuous if the program was going to be longer. Regarding the 1.57˚ improvement in the control group we can say that it is not to be considered as it did in the experimental group. We think that the changes that took place in the experimental group confirmed the hypothesis that to improve posture and balance in young people aged 19-22 years, intervention through functional exercises is more effective compared to traditional exercise training (exercise exercises).

Regarding the improvement of the equilibrium as mentioned in the discussion where based on the results from the second measurement of the intervention and control group showed that the equilibrium was improved more in the group that was angaged in the functional training exercise, compared with the the group whi was engaged in traditional fitness training, but this improvement was not statistically significant.

And finally, considering objective 3 that was, identifying a link between the possible improvements of the posture in relation to balance, again based on the results of the second measurements, we can say that there is a link between improving the posture and improving the equilibrium.

Consequently, knowing that a good posture spends less energy than a poor posture, we realize that a better balance also requires less energy expenditure. This fact was understood by the elliptical shape that emerges in the graph shown in the report released by Leonard's platform. The CoF (Center of Force) values go up to point 0 and consequently the signs that appears in the elliptical areas are more concentrated and smaller.

Based on the above we can say and recommend that;

- It is necessary to carry out other intrusive studies extended over a longer period of time with similar programs of younger age group subjects where there is still no complete ossification.
- It would also be of interest but also very important to build a national plan and system to be extended to the whole education system and not just to control and evaluate posture problems from early childhood, whereby definitely include physical education specialists.
- To create a plan for introducing functional training elements related to postural improvements in physical education curricula, in order to prevent the pathologies associated with the posture and their improvement.
- Creation of a specific posture testing and rehabilitation labs in collaboration with orthopedic doctors specialized on these pathologies.

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