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ALTERED POSTURAL CONTROL STRATEGIES IN PEOPLE WITH CHRONIC LOW BACK PAIN: AN OVERACTIVE LATISSIMUS DORSI?

STRATEGII ALTERATE DE CONTROL POSTURAL LA PERSOANELE CU DURERE LOMBARĂ CRONICĂ: POSIBILĂ HIPERACTIVITATE A MARELUI DORSAL/ LATISSIMUS DORSI?

Regina FINTA[1], Peter KATONA[2], Edit NAGY[3]

Abstract

Purpose: The aim of the research is to examine the possible alterations in the functioning of muscles in chronic low back pain (LBP). *Method:* In this prospective study 35 people were selected into LBP and control (C) groups after they had completed the Chronic Pain Grade Scale. 12 muscles were measured with surface electromyography during a functional balance task. *Results:* In rate of muscle recruitment significant increase was found, the LBP group recruited latissimus dorsi muscle (LD) to implement the movement task. During the functional task, the agonist muscles in the LBP group were not recruited as much as in the C group; however, the antagonist muscles were activated more frequently in the LBP group. The activity level of the agonist and stabilizer muscles was higher in the LBP group, whereas the activity level of antagonists was rather lower in the LBP group than in the C one. *Conclusion:* People with LBP recruit more antagonist muscles but use these muscles at a lower activity level. In the recruitment pattern, the role of LD seems to be dominant. Clinicians should consider the role of LD in LBP during the rehabilitation process.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Keywords: *low back pain, electromyography, antagonists, latissimus dorsi*

Rezumat

Scop: Scopul acestui studiu este de a examina posibilele alterări ale funcției musculare în durerea lombară joasă (LBP). *Metode:* Studiul s-a realizat pe un număr de 35 de subiecți, împărțiți în grupul cu LBP și grupul de control (C), în urma complectării Scalei gradate de durere cronică. Au fost evaluate 12 grupe musculare cu ajutorul electromiografiei, în timpul executării testului de echilibru funcțional. *Rezultate:* S-a depistat o rată crescută de recrutare musculară a marelui dorsal/ latissimus dorsi (LD), la subiecții din grupul LBP, în momentul menținerii echilibrului funcțional. S-a observat de asemenea o recrutare mai redusă a mușchilor agoniști la subiecții LBP decât la pacienții din grupul de control; cu toate acestea,

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mușchii antagoniști au fost activați mai frecvent la pacienții LBP. Nivelul de activare a mușchilor agoniști și stabilizatori a fost mai mare la pacienții LBP, în timp ce nivel de activitate a antagoniștilor a fost mai redus la acești pacienți, față de cei din grupul C. *Concluzii:* Persoanele cu dureri lombare recrutează mai mult mușchii antagoniști dar folosesc acești mușchi la un nivel de activitate mai redus. În cadrul paternului de recrutare, rolul marelui dorsal pare să fie dominant. Clinicienii ar trebui să ia în considerare rolul marelui dorsal în cadrul procesului de recuperare a pacienților cu dureri lombare.
Acest studiu nu a beneficiat de granturi specifice din partea unor agenții de finanțare din sectorul public, comercial sau non-profit.

Cuvinte cheie: *durere lombară joasă, electromiografie, antagoniști, marele dorsal*

Introduction

Lumbar spine stability is provided by the vertebrae, discs, ligaments, and muscles. If any of them are impaired, lumbar spine instability may occur [1]. Co-ordinated action occurs within groups of synergistically acting muscles and extends to agonist and antagonist muscle interactions, and proprioception from muscles is a primary sensory mechanism for motor control. Muscle actions must be precisely coordinated to occur at the correct timing, for the appropriate duration, and in the correct combination of forces [2]. No single muscle possesses the dominant responsibility in providing lumbar spine stability [3-5] but the role of the antagonists has been emphasized. Generally, the muscles that were antagonists to the dominant moment of the task were most effective at increasing stability [3, 4]. In case of instability, prolonged muscular compensation to maintain the mechanical stability of the spine may lead to chronic LBP [4]. The role of stabilizer muscles is evident, improving only one of them has a significant effect on the function of other stabilizers muscle and in reducing the intensity of lumbar pain [6, 7].

In a study, the authors have investigated the effect of a 10-minute deep upper trunk flexion exercise on the activity pattern of trunk muscles. They postulate that because of the deep flexion exercise, extensors become relaxed, the ligaments become stretched in the lumbar region, and these changes lead to temporary spinal instability. Due to the instability, the activity of the trunk muscles may change. Healthy subjects were asked to be in a sitting position and perform and then maintain this bending position for 10 minutes. Before and after this deep flexion stretch, various exercises were performed, such as maintaining a plank posture, or an isometric back extension posture, and perform a walking exercise. During the abovementioned activities, they have recorded the EMG activity of the rectus abdominis (RA), the abdominal external oblique (EO), and the erector spinae (ES) muscles. They found that there were no differences in the functioning of the agonist muscles, but the functioning of the antagonists changed significantly. When the subjects made the plank exercise, the activity of the ES muscles decreased significantly after the maintained deep flexion posture compared to the activity before the bending exercise. The activity of the flexor muscles, when the back extension exercise was performed, was also lower after the deep flexion. Researchers have come to the conclusion that the instability, which is caused by the static deep flexion occurring in the lumbar region, primarily affects the activity of the antagonist muscles. The motor control is affected because antagonist co-activation has been deteriorated by the increased joint laxity. Based on their results, researchers claim that antagonist muscles may be the indicator of stability problems, and by examining the antagonist muscles, we can identify the minor changes in spinal instability earlier [8].

Pain and motor control

There are several studies which support the notion that pain can change the motor control [9], [10]. Neuromuscular dysfunction may be caused by the low afferent variability of the peripherial proprioceptive receptors. Abnormal articular afferent information may decrease the gamma motor neuron excitability causing proprioceptive deficiencies, and joint damage may decrease alfa-motor neuron excitability reducing voluntary activation [11-13]. Reduced proprioceptive input may cause neuromuscular deficiencies; this constant malfunctioning of neuromuscular control and flawed regulation of dynamic movements may lead to inappropriate muscular activity (i.e., overutilization or underutilization). These studies suggest that altered neural control is a protective reaction of the body to limit provocation of the painful area. Which may cause further deteriorations, and it exacerbates the symptoms through the sensitization of the peripheral and central nervous systems (lowering of pain threshold), and it promotes dysfunctional movement patterns. Motor control changes result in modified muscle recruitment patterns, reduced postural robustness, and proprioceptive dysfunction [14].

In our study, we examined the postural muscle activity pattern in LBP group compared with pain-free subjects. We postulate that the rate of recruitment of trunk muscles responsible for posture can change due to back pain; therefore, individuals with LBP will react differently during a weight-bearing task.

Methods

Participants

35 subjects (24 women, 11 men) were included. The mean age of women was 24 years (SD 3.99), and it was the same (24 years; SD 3.69) in case of men. 91.3% of the subjects were right-handed. Those conditions except pain which were likely to affect the posture and the activity of muscles (neurological, internal organ problems, gynecological illnesses, further operations, balance and perception disorders) were considered as the exclusion criteria of the assessment. All procedures were performed in compliance with relevant laws of the country, wherein the study was conducted, and are in line with the Declaration of Helsinki. The subjects took part in the research voluntarily; they were informed about the procedures, and they gave their informed consents.

Measures

Functional exercise during the EMG measurement

The subjects were in a standing position, one of their legs was resting on a foot stool (30 cm high). The arms were held in a straightforward position, parallel to each other. The eyes focused on one point on the wall, which was 3 m from the subject. On a verbal command, the leg on the stool was lifted up about 2 cm high; this position had to be maintained for 2 seconds, and then the leg was put back onto the stool. Then the position of the lower extremities was interchanged. Our intention was to examine a functional posture, but not in a comfortable, stable position, so we made the exercise more difficult. The subjects had to balance their body in one leg standing position, with arms elevated forward in 90°, and changing the weight distribution; therefore, the postural control was challenged more. Because of the unstable and weight-bearing position, we expected the increased activity of the prime mover trunk and hip muscles. During this exercise, we recorded the EMG signals for 5 seconds (Figure 1).

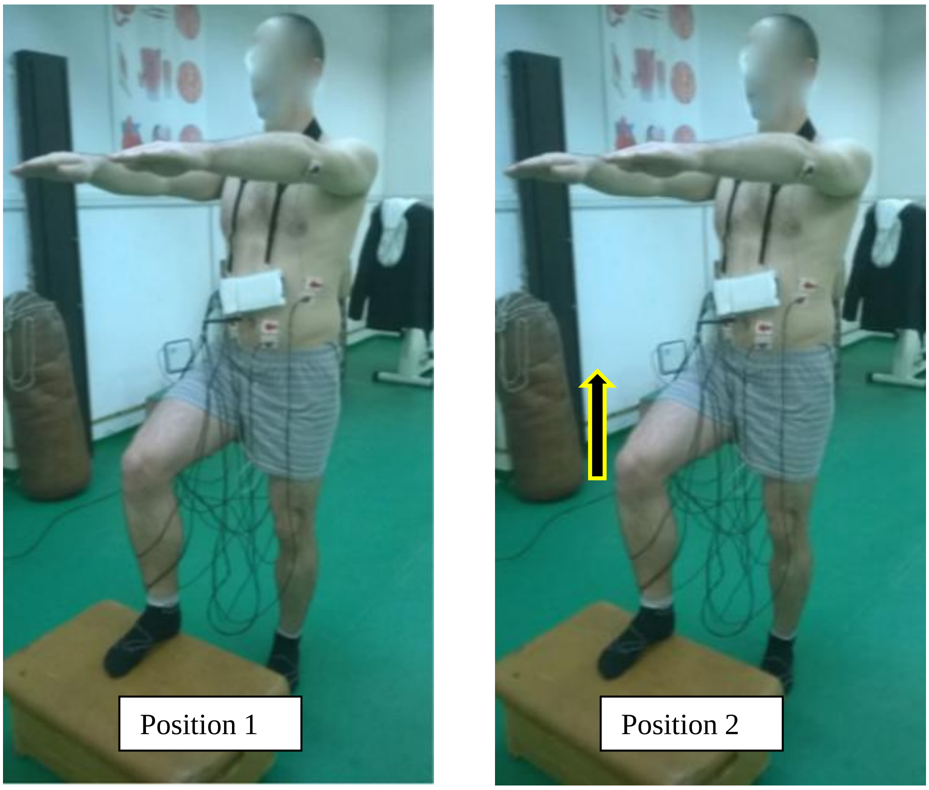

Figure 1: The functional task.
In the case of Position 1 the right leg of the subject was resting on a foot stool and then (Position 2) on a verbal command, the right leg on the stool was lifted up about 2 cm high; this position had to be maintained for 2 seconds, and then the leg was put back onto the stool. Then the position of the lower extremities was interchanged, therefore the task was repeated with the left leg.

EMG analysis

The surface EMG (TelemyoMini 16, Noraxon U.S.A. Inc. Scottsdale, Arizona, USA) electrodes were put on the assessed muscles according to the muscle belly. In the examination, we measured the rectus abdominis (RA), latissimus dorsi (LD), lumbar multifidus (MF), gluteus medius (GM), and gluteus maximus (GMax) muscles. The electrodes were placed and sort out and the skin surface was prepared according to the recommendations of SENIAM (http://seniam.org), the sampling rate was 1000 Hz. We assessed the muscles of both sides of the body (L: left, R: right), altogether with 10 channels. We chose these particular muscles because they play a significant role in trunk and pelvic stability.

Design and Procedures

The examination took place in a motion analyzation room in quiet circumstances. The procedure took a half an hour and the measured movement was coordinated by a physiotherapist.

Grouping

The grouping of the participants was according to the Chronic Pain Grade Scale [16]. 12 subjects, the members of the groups grade (G) II and G III were the subjects with chronic LBP, and there were 12 people without any complaints in the control (C) group. The subjects of G I were characterized by very low pain intensity, but they were affected by the pain. Therefore, we excluded G I subjects (n=11) from the further data processing.

Data analysis

We defined the recorded muscles as agonists, antagonists, and stabilizers considering the movement task, based on the book of Kinesiology of the Musculoskeletal System by Neumann [17] (Table 1.). Ipsilateral (ila.) muscle refers to the muscle located on the actual side of the body, where leg lifting occurred. Contralateral (cla.) describes the muscle located on the opposite side of the body of the leg lifting. Bilateral (bla.) muscles are located on both parts of the body.

Right leg lifting			
	agonists	antagonists	stabilizers
	R RA	R Gmax	L GM
	R GM	R LD	L Gmax
		L LD	L MF
			R MF
Left leg lifting			
	agonists	antagonists	stabilizers
	L RA	L Gmax	R GM
	L GM	L LD	R Gmax
		R LD	R MF
			L MF

Table 1: Categorisation of the muscles

(Abbrevations: R: right, L: left, RA: m. rectus abdominis, GM: m. gluteus medius, Gmax: m gluteus maximus, LD: m. latissimus dorsi, MF: m. multifidus lumborum)

EMG amplitudes (in microvolts) in time domain (in milliseconds) were used for analysis. We assessed the activity level of the muscles and the rate of the recruitment. The muscles' peak activation levels were obtained during the task and EMG signals were normalized to the peak activation levels. The rate of recruitment was expressed as the percentage of the total group members who have activated a muscle above the activation threshold. The activation threshold was set at the level of 45% of the maximal amplitude [18]. Lancosh FIR filters were applied: a band-pass filter (cut-off frequencies of 20 and 350 Hz) and a rejector filter (cut-off frequencies of 50 and 60 Hz). Then the integrated EMG was calculated, therefore no smoothing was applied.

Statistical Analysis

The data gathered were analysed with the help of STATISTICA 12 (Statistica Inc., Tulsa, Oklahoma, USA) using Mann–Whiney U test and Fisher's exact test.

Results

The rate of recruitment

We found that the differences in activity ratio of muscles in the LBP and C groups are bigger during right leg lifting. During right leg lifting, we can see that the agonist muscles did not recruit in the LBP group as much as in the C group. On the other hand, the antagonists ila. Gmax and bla. LD were activated more frequently in the LBP group than in the C group. Using Fisher's exact test, we found significant difference in the case of the LD activation pattern comparing the EMG data of the LBP and the C groups, when we examined the rate of recruitment of the muscles. This difference was marked during the lifting of the right leg and in the muscles on the right side (P=0,046). In case of the cla. and ila. MFs, there were also difference detected in recruitment; in the

LBP group, these muscles were activated more frequently. Stabilizer muscles were mostly over-recruited in the LBP group compared to the C group, but this tendency was not significant in this sample (Figure. 2, 3).

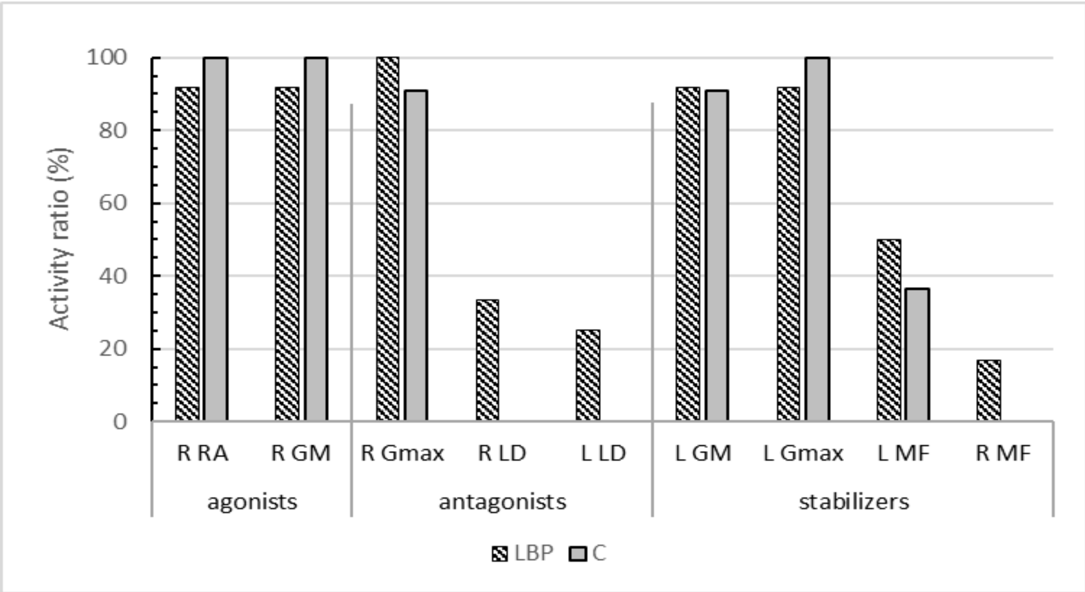

Figure 2: Activity ratio of muscles during right leg lifting.
*Antagonist muscles and bla. MFs (stabilizers) were recruited more often in the LBP group than in the C group, although agonist muscles were recruited less often in the LBP group. * P<0.05*
(Abbrevations: R: right, L: left, RA: m. rectus abdominis, GM: m. gluteus medius, Gmax: m gluteus maximus, LD: m. latissimus dorsi, MF: m. multifidus lumborum)

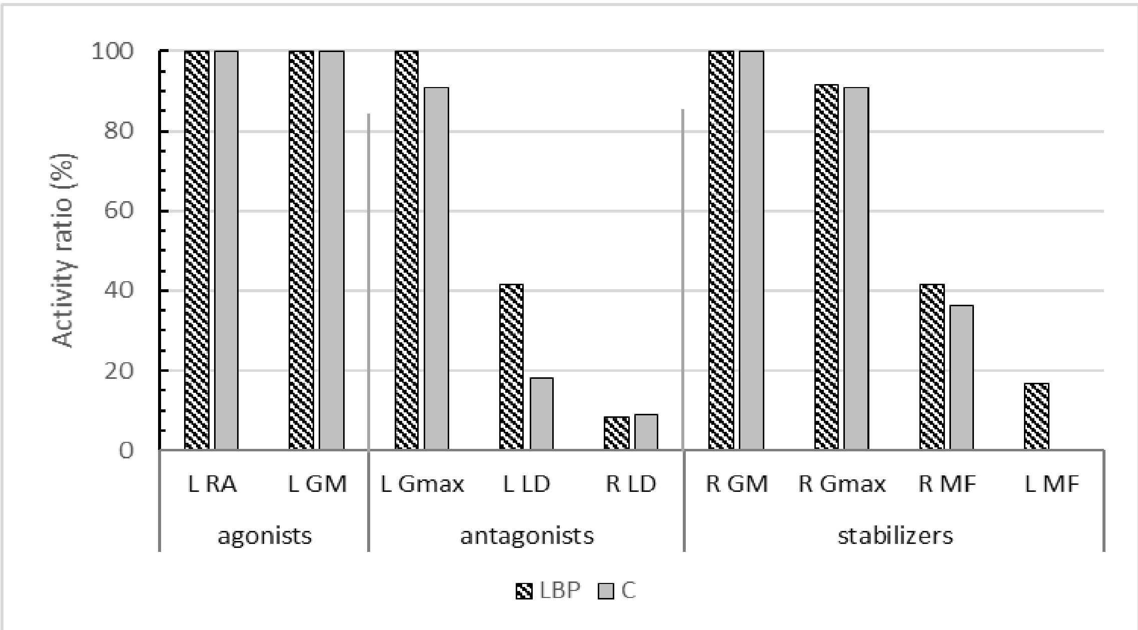

Figure 3: Activity ratio of muscles during left leg lifting.
Antagonist and stabilizer muscles were recruited more often in subjects with LBP. On the other hand, in the case of agonist muscles, we could not find any difference between the groups.
(Abbrevations: R: right, L: left, RA: m. rectus abdominis, GM: m. gluteus medius, Gmax: m gluteus maximus, LD: m. latissimus dorsi, MF: m. multifidus lumborum)

Electrical activity of muscles

Comparing the activity levels of the muscles, we did not find statistically significant differences between the LBP and C groups. On the other hand, we could see clear tendencies. During the one leg stance task, the activity level of agonist and stabilizer muscles was higher in the LBP group, while the activity level of the antagonist muscles was rather lower in the LBP group than in the C group (Figure. 4).

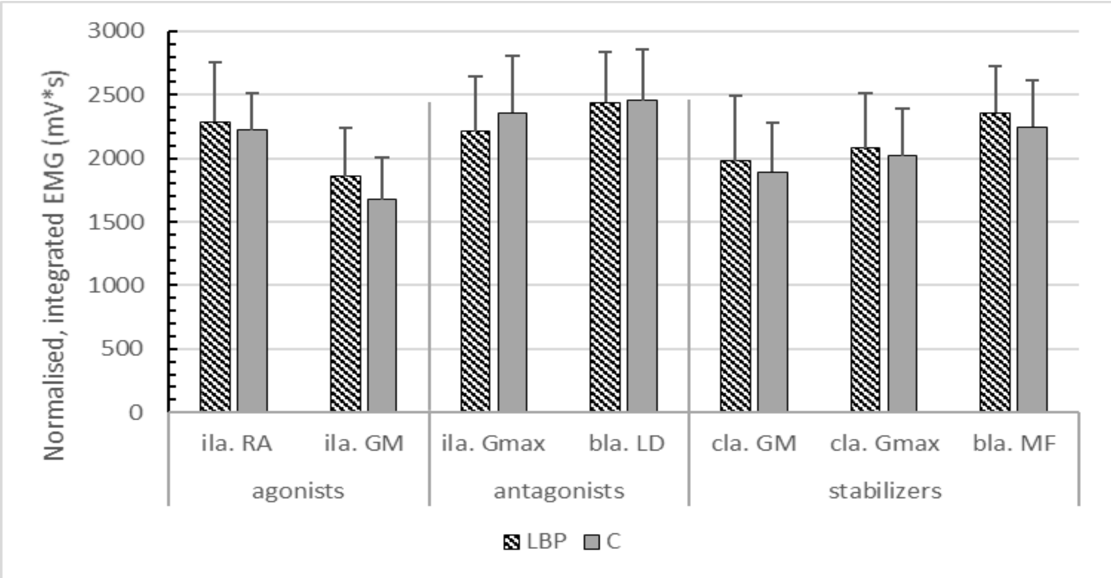

Figure 4: Electrical activity of muscles.
This figure shows the assessed muscles' EMG activity. The LBP group activated agonist and stabilizer muscles at a higher level, and antagonists at a lower level compared to the results of the C group.
(Abbrevations: ila: ipsylateral, bla: bilateral, cla: contralateral, RA: m. rectus abdominis, GM: m. gluteus medius, Gmax: m gluteus maximus, LD: m. latissimus dorsi, MF: m. multifidus lumborum)

DISCUSSION AND CONCLUSION

The rate of recruitment – the role of LD and Gmax in lumbar stability

The main finding of our study was that the postural muscles were recruited differently in LBP, and our results showed that subjects with LBP recruited antagonist muscles and used LD muscle to implement a weight-bearing movement in contrary to the C group, where LD muscle was activated in lesser extent. Antagonists Gmax and LD were recruited more often by the LBP group in contrast with the C group. It is known from a former study that these bridging (multi-joint) muscles make connection between the pelvis and the upper and lower extremities by the thoracolumbar fascia (TLF). Hence, parts of these muscles provide a pathway for mechanical transmission between the pelvis and the trunk. TLF plays an important role in transferring forces between spine, pelvis and legs and in the stabilization of the lower lumbar spine and sacroiliac joint. The tension of the TLF can be influenced by contraction or stretching of a variety of muscles. It is noteworthy that especially muscles such as the LD and Gmax are capable of exerting a contralateral effect especially on the lower lumbar spine and pelvis. It implies that the one-sided Gmax and cla. LD can both tension the TLF; thus, they have an important role in lumbar stability [19]. These findings and our results confirm the statement that no single muscle possesses a dominant responsibility in providing lumbar spine stability [3-5]. Generally, the muscles that were antagonist to the dominant moment of the task were most effective in increasing the stability [3, 4].

The global trunk muscles, such as the LD or the ES, are secondarily responsible for spinal stability [20]. Santos et al. have examined subjects who had to raise themselves from a kneeling position to a half kneeling position, which included weight shifting, and then asymmetrical weight bearing. Their results were that the IO and GM muscles reached higher peak amplitude in a short period of time in the C group, and the integrated EMG values were also higher than that of the members in the group with lumbago. It was also interesting that the subjects of the group with LBP activated the ES muscle with higher level and with earlier times of peak amplitude during changing their positions [21]. Our findings concerning the rate of recruitment further supports this interpretation; the subjects with LBP recruited LD, which is a global stabilizer like ES, during performing their exercises displaying an overactivity pattern of LD, which is otherwise a secondary stabilizer muscle. Although our results concerning the activity level seem to be in contradiction with theirs. In our functional exercise, the emphasis was on full weight bearing in one leg standing (more static activation), while in the abovementioned situation, the emphasis was on weight shifting (more dynamic activation). It can explain the differences found in the activity level in case of LD, that is, we recorded lower activity level in contrary to the results of Santos et al., since to hold a position requires lower activity level than to move a body part.

Interestingly, the results show that differences in the activity ratio of muscles of the LBP and C groups are larger under right leg lifting. We hypothesized that the results might be influenced by the subjects' right-handedness nevertheless, we did not measure how side dominance affected the motor pattern in LBP. Regarding this fact and the limited case number further researches are required to clarify the effect of hand dominance and the changes in motor control and motor activation pattern in LBP.

Electrical activity of muscles in LBP

It is well known that MF has an important role in stabilising the spine. MF has also a connection to TLF. Increased tone in the lumbar MF muscle should act to increase the tension created by the TLF between posterior superior iliac spines bilaterally. This increased medially directed tension would lead to force-closure of the sacroiliac joint, thus stabilizing the pelvis [19]. We expected, based on former studies, a lower activity level of the stabilizer muscles, such as MF, in the LBP group. In contrary to our expectation, we found the tendency of higher activity level and higher recruitment rate of MF muscle in the LBP group, together with lower activation level of antagonists, but without statistically significant differences. These findings may suggest that the main factor in the instability is more linked to the antagonist lower activity level and the lack of normal coactivation pattern of agonists and antagonists. That might also be the sign of spinal instability presented in our subjects with LBP, or this type of muscular compensation pattern has led to the development of chronic LBP [4].

Activity of antagonist muscles in LBP

We found that antagonist muscles (Gmax, LD) tended to reach a lower activity level in the LBP group. Recent research has revealed that if there is an increase in the instability around the lower back, or if the subject suffers from LBP, the activity level of the muscles decreases in the antagonists during the performance of a given exercise. Lee et al. have investigated the effect of a 10-minute deep upper trunk flexion exercise on the activity pattern of trunk muscles. They have postulated that because of the deep flexion exercise, spinal instability occurs. They have recorded the EMG activity of the trunk muscles, and found that in the functioning of the agonist muscles, there have been no differences, but the functioning of the antagonist muscles have changed significantly. The researchers have come to the conclusion that the instability, which has been caused by the static deep flexion occurring in the lumbar region, has primarily affected the activity of the antagonist muscles. Based on their results, the researchers claim that the antagonist muscles may be the indicator of stability problems. The tendencies in our results are in line with the abovementioned results. Even acute pain would cause changes in the activity of antagonist muscles. The researchers have injected hypertonic and isotonic solutions into the right longissimus dorsi (extensor) to cause acute pain. They examined the extensors, and the flexor muscles during the performance of trunk extension. The activity of the RA (flexor) muscle has been reduced due to the pain [22]. Their findings suggest that instability reduce the antagonist activity level, and our results provide more evidence for the reduced antagonistic activity in case of LBP.

Conclusion

These findings suggest that people with LBP recruit more antagonist muscles, but they use these muscles in a lower activity level, while the activity of agonist and stabilizer muscles shows an increased tendency. This change in motor control in individuals with LBP seems to be paradox, but it can be postulated that LBP causes lower activity level of the antagonist muscles first, which results in decreased spinal stability. The nervous system might try to repair the impaired stability, thus increasing the activity of the agonist and stabilizer muscles. To enhance the stabilization of the lumbar spine, the affected antagonist muscles are recruited more frequently but with a lower level of activity than in healthy people. We postulate that the change in motor control can be a pain avoidance strategy, based on the stability provided mostly by the superficial muscles instead of the deep, local stabilizing muscles, or a part of a fixation pattern, which is a negative postural control strategy. With higher stability, the pain can be reduced [2]. It has not been explained so far if LBP is caused by the pathological changes or the pain itself causes the chronic muscle and motor control dysfunction of the patients.

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References

[1] Ebenbichler, G. R., Oddsson, L. I., Kollmitzer, J., Erim, Z. (2001). Sensory-motor control of the lower back: implications for rehabilitation. *Medicine and Science in Sports and Exercise, 33*(11), 1889–1898. http://www.ncbi.nlm.nih.gov/pubmed/11689740

[2] Comerford, M. J., Mottram, S. L. (2001). Movement and stability dysfunction – contemporary developments. *Manual Therapy*, *6*(1), 15–26. https://doi.org/10.1054/math.2000.0388

[3] Kavcic, N., Grenier, S., McGill, S. M. (2004). Determining the stabilizing role of individual torso muscles during rehabilitation exercises. *Spine*, *29*(11), 1254–1265. http://www.ncbi.nlm.nih.gov/pubmed/15167666

[4] Cholewicki, J, McGill, S. M. (1996). Mechanical stability of the in vivo lumbar spine: implications for injury and chronic low back pain. *Clinical Biomechanics (Bristol, Avon)*, *11*(1), 1–15. http://www.ncbi.nlm.nih.gov/pubmed/11415593

[5] Cholewicki, Jacek, VanVliet, J. J. (2002). Relative contribution of trunk muscles to the stability of the lumbar spine during isometric exertions. *Clinical Biomechanics (Bristol, Avon)*, *17*(2), 99–105. http://www.ncbi.nlm.nih.gov/pubmed/11832259

[6] Finta, R., Nagy, E., Bender, T. (2018). The effect of diaphragm training on lumbar stabilizer muscles: a new concept for improving segmental stability in the case of low back pain. *Journal of Pain Research*, Volume 11, 3031–3045. https://doi.org/10.2147/JPR.S181610

[7] Finta, R., Boda, K., Nagy, E., Bender, T. (2020). Does inspiration efficiency influence the stability limits of the trunk in patients with chronic low back pain? *Journal of Rehabilitation Medicine*, *52*(3), jrm00038. https://doi.org/10.2340/16501977-2645

[8] Lee, N., Kang, H., Shin, G. (2015). Use of antagonist muscle EMG in the assessment of neuromuscular health of the low back. *Journal of Physiological Anthropology*, *34*, 18. https://doi.org/10.1186/s40101-015-0055-5

[9] Hodges, P. W., Richardson, C. A. (1996). Inefficient muscular stabilization of the lumbar spine associated with low back pain. A motor control evaluation of transversus abdominis. *Spine*, *21*(22), 2640–2650. http://www.ncbi.nlm.nih.gov/pubmed/8961451

[10] Johanson, E., Brumagne, S., Janssens, L., Pijnenburg, M., Claeys, K., Pääsuke, M. (2011). The effect of acute back muscle fatigue on postural control strategy in people with and without recurrent low back pain. *European Spine Journal : Official Publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society*, *20*(12), 2152–2159. https://doi.org/10.1007/s00586-011-1825-3

[11] Hurley, M. V., Newham, D. J. (1993). The influence of arthrogenous muscle inhibition on quadriceps rehabilitation of patients with early, unilateral osteoarthritic knees. *Rheumatology*, *32*(2), 127–131. https://doi.org/10.1093/rheumatology/32.2.127

[12] Hurley, M. V, Scott, D. L., Rees, J., Newham, D. J. (1997). Sensorimotor changes and functional performance in patients with knee osteoarthritis. *Annals of the Rheumatic Diseases*, *56*(11), 641–648. http://www.ncbi.nlm.nih.gov/pubmed/9462165

[13] Hurley, M. V. (1999). The role of muscle weakness in the pathogenesis of osteoarthritis. *Rheumatic Diseases Clinics of North America*, *25*(2), 283–298, vi. http://www.ncbi.nlm.nih.gov/pubmed/10356418

[14] McCaskey, M. A., Schuster-Amft, C., Wirth, B., Suica, Z., de Bruin, E. D. (2014). Effects of proprioceptive exercises on pain and function in chronic neck- and low back pain rehabilitation: a systematic literature review. *BMC Musculoskeletal Disorders*, *15*, 382. https://doi.org/10.1186/1471-2474-15-382

[15] *http://seniam.org/*. (n.d.). Retrieved February 18, 2018, from http://seniam.org/

[16] Von Korff, M., Ormel, J., Keefe, F. J., Dworkin, S. F. (1992). Grading the severity of chronic pain. *Pain*, *50*(2), 133–149. http://www.ncbi.nlm.nih.gov/pubmed/1408309

[17] Neumann, D. A. (2002). *Kinesiology of the musculoskeletal system : foundations for physical rehabilitation*. Mosby.

[18] Halaki, M., Gi, K. (2012). Normalization of EMG Signals: To Normalize or Not to Normalize and What to Normalize to? In *Computational Intelligence in Electromyography Analysis - A Perspective on Current Applications and Future Challenges*. InTech. https://doi.org/10.5772/49957

[19] Willard, F. H., Vleeming, A., Schuenke, M. D., Danneels, L., Schleip, R. (2012). The thoracolumbar fascia: anatomy, function and clinical considerations. *Journal of Anatomy*, *221*(6), 507–536. https://doi.org/10.1111/j.1469-7580.2012.01511.x

[20] Chang, W.-D., Lin, H.-Y., Lai, P.-T. (2015). Core strength training for patients with chronic low back pain. *Journal of Physical Therapy Science*, *27*(3), 619–622.

https://doi.org/10.1589/jpts.27.619

[21] Santos, F. G., Carmo, C. M., Fracini, A. C., Pereira, R. R. P., Takara, K. S., Tanaka, C. (2013). Chronic Low Back Pain in Women: Muscle Activation during Task Performance. *Journal of Physical Therapy Science*, *25*(12), 1569–1573. https://doi.org/10.1589/jpts.25.1569

[22] Hirata, R. P., Salomoni, S. E., Christensen, S. W., Graven-Nielsen, T. (2015). Reorganised motor control strategies of trunk muscles due to acute low back pain. *Human Movement Science*, *41*, 282–294. https://doi.org/10.1016/j.humov.2015.04.001

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HIP ASSESSMENT IN PATIENT WITH PRIMARY AND SECONDARY HIP ARTHRITIS

EVALUAREA FUNCŢIEI ŞOLDULUI LA PACIENTUL CU COXARTROZĂ PRIMARĂ ȘI SECUNDARĂ

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Abstract

Introduction. Hip arthritis, also called coxo-femoral osteoarthritis or osteoarthritis of the hip, is a chronic condition characterized by the progressive destruction of articular cartilage at the coxo-femoral level.

Aim. This paper aims to perform a functional analysis of the hip joint in the context of primary and secondary hip osteoarthritis, as well as the impact of this condition on the quality of life of people diagnosed with this disease, translated by affecting patients' ability to perform daily activities, work and social.

Material and method. Thirteen patientsdiagnosed with hip osteoarthritis, aged between 45 and 80 years, with moderate or severe pain, restrictions in joint mobility, and difficulties in walking, stair climbing, or putting on shoes, volunteered to participate in this trial and gave their informed consent. Subjects were assessed for range of motion (ROM) using the goniometer, for muscle strength (manual muscle testing), hip function (WOMAC score).

Results. In ROM assessment we found limitations in all direction of hip movement. Also, a decreased muscle strength for all hip muscle, especially for hip abdductors and adductors and also for hip internal and external rotators. in most patients with primary osteoarthritis, the pain is moderate, with moderate limitation of range of motion and moderate loss of function.

Conclusion. In patients with primary and secondary hip osteoarthritis, the muscular force of the abductors and adductor muscles, of the internal and external rotators and less of the flexors and extensors is reduced. The joint amplitude is reduced especially on flexion, abduction and adduction, internal and external rotation and almost not on extension. The functional deficit is average in terms of joint amplitude, limited mobility, the pain is of medium intensity.

Key words: *hip osteoarthritis, range of motion, muscle strength, hip function, WOMAC score*

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Rezumat

Introducere. Coxartroza, numită și osteoartrita coxo-femurală sau osteoartrita de șold, este o afecțiune cronică caracterizată prin distrugerea progresivă a cartilajului articular la nivel coxo-femural.

Scop. Lucrarea de față își propune să realizeze o analiză funcțională a articulației șoldului în contextul osteoartritei primare și secundare de șold, precum și impactul acestei afecțiuni asupra calității vieții persoanelor diagnosticate cu această boală, tradusă prin afectarea capacității de performanță a pacienților. activități zilnice, de muncă și sociale.

Material și metodă. Treisprezece pacienți diagnosticați cu osteoartrită de șold, cu vârste cuprinse între 45 și 80 de ani, cu durere moderată sau severă, restricții ale mobilității articulare și dificultăți la mers, urcat scările sau încălțare, s-au oferit voluntar să participe la acest studiu și și-au dat consimțământul informat. Subiecții au fost evaluați pentru amplitudinea de mișcare (ROM) folosind goniometrul, pentru forța musculară (testarea musculară manuală), funcția șoldului (scorul WOMAC).

Rezultate. În evaluarea ROM s-auevidențiat limitări în toate direcțiile de mișcare a șoldului. De asemenea, s-a observat o scădere a forței musculare pentru toți mușchii șoldului, în special pentru abductorii și adductorii șoldului și, de asemenea, pentru rotatorii interni și externi. La majoritatea pacientilor cu osteoartrita primara, durerea este moderata, cu limitare moderata a amplitudinii de miscare si pierdere moderata a functiei.

Concluzie. La pacientii cu ocoxartroză primară si secundară de șold, este redusă forța muscularăa abductorilor si adductorilor, a rotatorilor interni și externi și mai puțin a flexorilor și extensorilor. Amplitudinea articulară este redusă mai ales la flexie, abducție și adducție, rotație internăși externăși aproape deloc la extensie.Deficitul funcțional este mediu în ceea ce privește amplitudinea articulară și limitarea mobilității, durerea fiind de intensitate medie.

Cuvinte cheie: *coxartroză, amplitudine articulară, forță musculară, funcția șoldului, scorul WOMAC*

Introduction

Hip arthritis, also called coxo-femoral osteoarthritis or osteoarthritis of the hip, is a chronic condition characterized by the progressive destruction of articular cartilage at the coxo-femoral level.

Osteoarthritis (OA) is a disease with a slow onset, on average after the age of 50, presenting with joint pain and stiffness, swelling, and instability resulting in functional impairment in daily activities [1]. It has a progressive, continuous evolution that eventually leads to ankylosis (blockage) of the hip joint, accompanied by very severe pain. Consequently, symptomatic hip OA often leads to hip replacement surgery. [2, 3]

It is often a disease present in the elderly and the elderly [4]. It can also occur in young people, following a very strong trauma to the hip: hip dislocation, femoral head fracture, or it can occur secondarily in the context of other diseases treated incorrectly or neglected: congenital hip dislocation, epiphysiolysis, Rheumatoid arthritis, Calvé-Legg-Perthes disease, congenital dysplasia of the hip [5].

Because there is no known cure for OA, clinical management of hip OA is mainly targeting pain reduction, increasing hip function and therefore the quality of life. [6]

In patients with hip osteoarthritis, a lack of strength lower extremity muscle was found, but there is less literature and lack of supporting evidence on muscle strength in hip OA or on which muscles are most affected [7, 8]. This generalized muscle weakness may be due to muscle atrophy, reduced muscle density [9], and muscle inhibition [10]. Because of lower limb muscle weakness, it is very important to determine the mechanisms underlying this condition, in order to develop efficient rehabilitation programs for hip osteoarthritis in order to prevent the development of strength asymmetries characteristic of advanced hiposteoarthritis. [11]

In osteoarthritis condition, there is a failure in the dynamic equilibrium between the breakdown and repair of joint tissues. Structural destruction of the articular cartilage can be due to the abnormal mechanical strains of the cartilage and also due to influence of physiological mechanical strains. [12]

Pain can be very debilitating and therefore can have a significant impact on the physical function and quality of life of patients with hip osteoarthritis. [13]

Aim

This paper aims to perform a functional analysis of the hip joint in the context of primary and secondary hip osteoarthritis, as well as the impact of this condition on the quality of life of people diagnosed with this disease, translated by affecting patients' ability to perform daily activities, work and social.

Study design

Participants

Participants were recruited from the Felix Spa Clinical Hospital of Medical Rehabilitation and OsteoKinetoMedica private practice clinic. Thirteen patients diagnosed with hip osteoarthritis, aged between 45 and 80 years, with moderate or severe pain, restrictions in joint mobility, and difficulties in walking, stair climbing, or putting on shoes, volunteered to participate in this trial and gave their informed consent. They responded to a self-reported questionaire regarding health, comorbidities, medication, and workplace. Participants were undergo to an examination, which included measurements of physical functioning (strength, mobility, pain intensity and activities of daily living).Inclusion criteria were age ≥ 45 years, primary and secondary hip OA with pain in the hip region (groin and lateral hip) during the last month.Exclusion criteria were bilateral total hip replacement, chronic conditions such as rheumatoid arthritis or major surgical procedures in the last 6 months (lower limb or lower back). Medication used was not an inclusion or exclusion criterion.

Assessment tools

Physical functioning (strengthand hip joint mobility) was measured objectively.

*Hip range of motion assessment.*To assess joint mobility we used the goniometer method to determine the degrees of flexion, extension, abduction, adduction, internal rotation and external rotation of the hip. [14]

*Hip muscle strength assessment.*In order to asses muscle straight manual muscle testing was used. Katharine M. and colab. (2011) showed that manual muscle testing (MMF) is used as a break testing. The subject is asked to held the body segment in place, against the tester's gradually increasing pressure. Break testing is described in Kendall and Kendall *Muscles Testing and Function* [15] and is graded on a 0 to 5 scale (Table 1). This resistance corresponds to the strength that the individual should possess according to sex, age, profession (the testator appreciating this level of resistance and according to his experience). If the muscle on the contralateral side can give valid information (it is normal), it will be used as a reference (control) to stabilize the resistance that should be defeated [16, 17]. In this study were assessed the following muscle groups: iliopsoas, sartorius, tensor fascia latae, gluteus maximus, gluteus medius, gluteus minimus, adductors group, pectineus, pelvitrochanteric muscles.

Table no. 1Manual muscle testing

Grade	
F0 (absent)	No elicited contraction
F1 (mild)	Flicker of movement
F2 (fair)	Through full range actively with gravity counterbalanced
F3 (good)	Through full range actively against gravity
F4 (very good)	Through full range actively against some resistance
F5 (normal)	Through full range actively against strong resistance

Pain and Self-Reported Physical Function

One of the aims of the study was hip joint pain assessed by the Western Ontario and McMaster University Osteoarthritis Index. WOMAC consist of three subscales (pain, stiffness, and physical function) and a total score (WOMAC Index) that reflects overall disability.

The test questions are scored on a scale from 0 to 4, which correspond as follows: none / none (0) // mild (1) // moderate (2) // severe (3) // extreme (4). This score includes 24 items, the minimum score is 0, and the maximum score is 96. The scores for each subscale are summed, with a possible score between: 0 and 20 for pain, 0-8 for mobility limitation, 0-68 for physical function. A high Womac score indicates extreme pain, severe limited mobility and major limitation of physical function. [18]

Statistical Analysis

For statistical analysis SPSS 15.0 was used. Values are presented as means and standard deviations (SD).

Results

All participants, 40% men, 60% women, were nonsmokin patients with mean age (SD) of 62.50 (6.0) years. Mean height was 164 (7.0) cm, weight was 78.40 (12.3) kg, and body mass index (BMI) was 29.07 (3.3) kg/m^2. The duration of illness was 11.25 (2.4). From all subjects (30), 90% had primary hip arthrosis and 10% had secondary hip arthrosis. Three women had no diagnosed illness other than hip OA, and the most common medication was for high blood pressure. No changes were made in OA medication during the intervention. The most often used medication was the NSAIDs (nonsteroid anti-inflammatory drugs).

Table no.2 Subjects characteristics

Nr. crt.	Subject characteristics	Mean ±Std.dev	Min.	Max.
1	Age	65.20± 6.0	45	80
2	Duration	11.25± 2.4	3	17
3	Heigh	1.64± 7.0	1.50	1.80
4	Weight	78.40± 12.3	65	95
5	BMI	29.07± 3.3	28.33	30.11
Nr. crt.	Subject characteristics	Frecv. %	Frecv. %	
6.	Gender	Men 40 %	Women 60 %	
7.	Diagnostic/ stage	Primare 90%	Secondary 10%	
8.	Lifestile	Sedentary life 90%	Active life 10%	
9.	Medication	Ketoprofen, Diclofenac, Hidrocortizon, Metilprednisolon, Hialuronic acid		

Table no. 3 Hip range of motion

Hip ROM	Mean±Std. Dev.	Min.	Max.	Normal value
Flexion with knee flexed	75.73±25.193	25	100	125
Flexion with knee extended	63.13±27.369	10	88	90
Extension	10.00±1.438	8	12	15
Abduction	29.20±12.430	14	45	60
Adduction	17.20±5.397	11	24	30
Internal rotation	8.03±2.092	5	10	15
Internal rotation	16.00±4.410	10	21	35

Comparing the results with normal hip flexion values with the knee flexed (125°) and the knee extended (90°), it can be seen that on average, the patients included in the study have an active flexion deficit of 46° with the knee flexed and 27° with the knee extended.

The largest difference in joint amplitude is 95º with the knee bent and 80º with the extended knee present in the patient diagnosed with secondary hip osteoarthritis and in the patient diagnosed with primary hip osteoarthritis the difference is 47º with the knee flexed and 27º with the knee extended. There is also a significant difference of 48º with the knee bent and 53º with the knee extended, regarding the joint aptitude of people with secondary and primary hip osteoarthritis, the latter having a higher mobility.

Comparing the results with the normal values of hip extension (15°), it can be seen that on average, the patients included in the study have an active extension deficit of 5°. The largest difference in joint amplitude is 7º present in the patient diagnosed with secondary hip osteoarthritis and in the patient diagnosed with primary hip osteoarthritis the difference is 6º. There is also a small difference of 1º regarding the joint aptitude of people with secondary and primary hip osteoarthritis, the latter having a slightly higher mobility.Comparing the results with the normal values of hip abduction (60°), it can be seen that on average, the patients included in the study have an active abduction deficit of 31°. The largest difference in joint amplitude is 46º present in the patient diagnosed with secondary hip osteoarthritis and in the patient diagnosed with primary hip osteoarthritis the difference is 43º. A small difference of 3º can also be seen in the joint aptitude of people with secondary and primary hip osteoarthritis, the latter having a slightly higher mobility.Comparing the results with the normal values of hip adduction (30°), it can be seen that on average, the patients included in the study have an active adduction deficit of 13 °. The largest difference in joint amplitude is 19º present in the patient diagnosed with secondary hip osteoarthritis and in the patient diagnosed with primary hip osteoarthritis the difference is 17º. There is also a small difference of 2º regarding the joint aptitude of people with secondary and primary hip osteoarthritis, the latter having a slightly higher mobility.

Comparing the results with the normal values of the internal rotation of the hip (15°), it can be seen that on average, the patients included in the study have an active internal rotation deficit of 7°. The largest difference in joint amplitude is 9º present in the patient diagnosed with secondary hip osteoarthritis and in the patient diagnosed with primary hip osteoarthritis the difference is 10º. There is also a small difference of 1º regarding the joint aptitude of people with secondary and primary hip osteoarthritis, the latter having a slightly lower mobility this difference can be explained due to aging and the onset of the pathology (17 years).

Comparing the results with the normal valuesof the external rotation of the hip (35°), it can be seen that on average, the patients included in the study have an active internal rotation deficit of 19°. The largest difference in joint amplitude is 25º present in the patient diagnosed with secondary hip osteoarthritis and in the patient diagnosed with primary hip osteoarthritis the difference is 23º. There is also a small difference of 2º regarding the joint aptitude of people with secondary and primary hip osteoarthritis, the latter having a slightly higher mobility.

Table no. 4 Muscle test results for hip strength

Flexion	Extensie	Abduction	Adduction	Internal rotation	Internal rotation	Min.	Max.
60% F3+	20% F3+	100% F3+	100% F3+	100% F3+	100% F3+	F0	F5
40% F4-	80% F4-	-	-	-	-		

From the data presented in the tables above it is observed that all patients have a muscle strength between F3 and F4. Force 3 means the force of a muscle to mobilize the tested lower limb against gravity. A higher force F4- and F4 is observed in flexion and extension movements, this "increased" force can be explained by the fact that these movements are performed by larger and more developed muscle groups, but also by the fact that these movements are used, especially in everyday life, in almost any circumstance: walking, getting out of bed, sitting on a chair, and in this way their hypotonia is slowed down.

Table no. 5 WOMAC score

	Mean±Std. Deviation	**Minimum**	**Maximum**	**Normal values Min./Max.**
WOMAC pain score	9.80±5.041	3	17	0/20
WOMAC mobility score	5.20±1.349	3	7	0/8
WOMAC joint function score	41.80±11.657	21	56	0/64
Total WOMAC score	57.00 ± 14.02	3	17	0/92

Comparing the results with the minimum (0) and maximum (20) values of the subscale, it can be seen that the average patient included in the study is 10. The maximum subscriber that can be obtained is 20. A large Womac subscale indicates extreme pain. The score of 10 out of 20 allows us to say that in most patients with primary hip osteoarthritis, the pain is moderate. The closest value (3) to the minimum value of the subscale (0) is present in the patient diagnosed with primary hip osteoarthritis, in which the pathology started 3 years ago. This subscript indicates that this patient has mild pain. The closest value (17) to the maximum value of the subscale (20) is present in the patient diagnosed with primary hip osteoarthritis, in whom the pathology began 17 years ago, which means that this patient has extreme pain.

Comparing the results with the minimum (0) and maximum (8) values of the subscale, it can be seen that the average patient included in the study is 5. The maximum subscriber that can be obtained is 8. A large WOMAC subscale indicates an excessive decrease in mobility. hip after the first half of walking and later in the day. The 5 out of 8 survey allows us to say that in most patients with primary hip osteoarthritis, mobility is quite low. The closest value (3) to the minimum value of the subscale (0) is present in the patient diagnosed with primary hip osteoarthritis, in which the pathology started 3 years ago. This subscript indicates that this patient has good joint mobility. The closest value (7) to the maximum value of the subscale (8) is present in the patient diagnosed with primary hip osteoarthritis, in whom the pathology began 17 years ago, which means that this patient has severe mobility limitations, especially morning.

Comparing the results with the minimum (0) and maximum (64) values of the subscale, it can be seen that the average patient included in the study is 42. The maximum subscriber that can be obtained is 64. A large Womac subscale indicates a deficit in joint function. of the hip in carrying out daily activities. The 42 out of 68 survey allows us to say that in most patients with primary hip osteoarthritis, they have a high deficit of hip joint function. The closest value (21) to the minimum value of the score (0) is present in the patient diagnosed with primary hip osteoarthritis, in which the pathology started 3 years ago. This score indicates that this patient does not encounter major difficulties during daily activities. The closest value (56) to the maximum value of the subscale (64) is present in the patient diagnosed with primary hip osteoarthritis, in whom the pathology began 17 years ago, which means that this patient encounters great difficulties during daily activities. and it also follows that he would need help to carry out some activities of daily living.

Comparing the results with the minimum (0) and maximum (92) score values, it can be seen that the average score is 57. The maximum score that can be obtained is 92. A high WOMAC score indicates extreme pain, severe limitation mobility and major limitation of physical function.

The score of 57 out of 92 allows us to say that in most patients with primary osteoarthritis, the pain is moderate, with moderate limitation of range of motion and moderate loss of function. The closest value (27) to the minimum value of the score (0) is present in the patient diagnosed with primary hip osteoarthritis, in which the pathology started 3 years ago. This score indicates that this patient has mild pain, with slight limitation of mobility and a reduced loss of hip function. The closest value (80) to the maximum value of the score (92) is present in the patient diagnosed with primary hip osteoarthritis, in which the pathology began 17 years ago, which means that this patient has extreme pain, severe limitation of mobility and major limitation of physical function.

Discussions

The aim of the present study was to perform an assessment of mobility, strength and hip function in patients with primary and secondary hip osteoarthritis. Regarding the hip range of motion, we can say that on average, there is an active flexion deficit of 46° with the knee flexed and 27° with the knee extended. There is also a significant difference of 48º flexion with the knee flexed and 53º with the knee extended, between people with secondary and primary hip osteoarthritis, the latter having greater mobility.

On average, hip extension (15° normal) in patients with primary and secondary hip osteoarthritis is not affected, with only a slight deficit of active extension of 5°. Regarding the extension deficit, there is no significant difference between patients with primary hip osteoarthritis and those with secondary hip osteoarthritis. Hip arthritis affects active abduction of the hip, which has an average deficit of 31° to normal (60°). There are no significant differences in the extent of abduction in patients with primary and secondary hip osteoarthritis, the deficit being only 3°. Hip arthritis also affects the adduction of the hip, on average the deficit being 13° compared to the normal active adduction (30°). There are no significant differences in the amplitude of adduction in patients with primary and secondary hip osteoarthritis, the deficit being only 3°. Internal and external rotation are affected approximately to the same extent, on average, patients with a deficit of external hip rotation of 7° to normal (15°), and a deficit of 19° of internal rotation to normal (35°). There are no significant differences in the amplitude of internal and external rotation in patients with primary and secondary hip osteoarthritis, the deficit being 2° and 1°, respectively.

Regarding the muscular strength at the level of the hip, in all patients the main muscle groups of the hip have forces between F3 and F4, which means that in hip osteoarthritis is also affected the muscular force, which decreases from a maximum of 5 to values of 3 and 4.

Regarding the assessment of pain, limited mobility and joint function, performed using the Womac Test, it is observed that on average, the patients included in the study have an average WOMAC score of 57 out of a maximum of 92, which means that in most patients with primary osteoarthritis and secondary, the pain is moderate, with moderate limitation of range of motion and moderate loss of function.

Conclusions

In conclusion, in patients with primary and secondary hip osteoarthritis, the muscular force of the abductors and adductor muscles, of the internal and external rotators and less of the flexors and extensors is reduced. The joint amplitude is reduced especially on flexion, abduction and adduction, internal and external rotation and almost not on extension, the functional deficit being average in terms of joint amplitude, limited mobility, the pain being of medium intensity.

References

[1] Kirsti Uusi-Rasi, Radhika Patil, Saija Karinkanta, Kari Tokola, Pekka Kannus, Harri Sievänen (2017) Exercise Training in Treatment and Rehabilitation of Hip Osteoarthritis: A 12-Week Pilot Trial, *Journal of Osteoporosis*, vol. 2017, Article ID 3905492. https://doi.org/10.1155/2017/3905492

[2] Lawrence RC, Helmick CG, Arnett FC, Deyo RA, Felson DT, Giannini EH, et al. (1998) Estimates of the prevalence of arthritis and selected musculoskeletal disorders in the United States. *Arthritis Rheum*; 41: 778–99.

[3] Lane NE. (2007) Clinical practice. Osteoarthritis of the hip. *N Engl J Med* ; 357: 1413– 21.

[4] W. Zhang, G. Nuki, R. W. Moskowitz et al. (2009) OARSI recommendations for the management of hip and knee osteoarthritis. Part III: changes in evidence following systematic cumulative update of research published through January 2009,*Osteoarthritis and Cartilage*, vol. 18, no. 4, pp. 476–499, 2010.View at: Publisher Site | Google Scholar

[5] Gunnar B. Flugsrud, Lars Nordsletten, Birgitte Espehaug, Leif I. Havelin, Haakon E. Meyer (2002), Risk factors for total hip replacement due to primary osteoarthritis: A cohort study in 50,034 persons, *Arthritis & Rheumatology*,Volume46, Issue3, March 2002, Pages 675-682

[6] Puett DW, Griffin MR. (1994) Published trials of nonmedicinal and noninvasive therapies for hip and knee osteoarthritis. *Ann Intern Med*; 121:133–40.

[7] Conaghan PG, Dickson J, Grant RL (2008) for the Guideline Development Group. Care and management of osteoarthritis in adults: summary of NICE guidance. *Br Med J*; 336:502–3.

[8] Rasch A, Dalen N, Berg HE. (2010) Muscle strength, gait, and balance in 20 patients with hip osteoarthritis followed for 2 years after THA. *Acta Orthop*.; 81:183–8.

[9] Grimaldi A, Richardson C, Durbridge G, Donnelly W, Darnell R, Hides J. (2009) The association between degenerative hip joint pathology and size of the gluteus maximus and tensor fascia lata muscles. *Man Ther*.; 14:611–7.

[10] Suetta C, Aagaard P, Magnusson SP, Andersen LL, Sipila S, Rosted A, Jakobsen AK, Duus B, Kjaer M. (2007) Muscle size, neuromuscular activation, and rapid force characteristics in elderly men and women: effects of unilateral long-term disuse due to hip-osteoarthritis. *J Appl Physiol*.; 102:942–8.

[11] Loureiro A, Mills PM, Barrett RS. (2013) Muscle weakness in hip osteoarthritis: a systematic review. *Arthritis Care Res.*; 65:340–52.

[12] Nuki, G. (1999) Osteoarthritis: a problem of joint failure. *Z Rheumatol* 58, 142–147. https://doi.org/10.1007/s003930050164

[13] Vos T, Flaxman AD, Naghavi M, et al. (2012) Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study. *Lancet.*; 380(9859):2163–96.

[14] Y.-H. Pua, T. W. Wrigley, S. M. Cowan, and K. L. Bennell (2008) Intrarater test-retest reliability of hip range of motion and hip muscle strength measurements in persons with hip osteoarthritis,*Archives of Physical Medicine and Rehabilitation*, vol. 89, no. 6, pp. 1146–1154, 2008.View at: Publisher Site | Google Scholar

[15] Kendall F.P., Kendall McCreary E., Provance P.G. (1993) *Muscles—testing and function. 4th ed. Williams and Wilkins*; Baltimore; pp.179–190. [Google Scholar]

[16] Elena Sîrbu, Mircea Chiriac, Dorina Ianc (2012), *Fundamentele kinetoterapiei - Noţiuni şi Tehnici*, Editura Universitaţii din Oradea, pp. 85.
[17] Katharine M. Conable, Anthony L. Rosner (2011) A narrative review of manual muscle testing and implications for muscle testing research, *J Chiropr Med*. Sep; 10(3): 157–165. doi: 10.1016/j.jcm.2011.04.001
[18] Theiler R, Spielberger J, Bischoff H.A., Bellamy N, Huber J, Kroesen S. (2002) Clinical evaluation of the WOMAC 3.0 OA Index in numeric rating scale format using a computerized touch screen version [abstract]. *OSTEOARTHR CARTILAGE*; 10(6):479-481

THE IMPORTANCE OF SOFT SKILLS IN FITNESS-SPECIFIC ACTIVITIES

IMPORTANTA ABILITĂŢILOR SOFT IN CADRUL ACTIVITATILOR SPECIFICE FITNESSULUI

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Abstract

Communication in sports is a process that is of great concern to specialists, but information related to this area is very poor. Jean Caune [3] pointed out that "cultural phenomena and communication processes are, more than ever, part of any community life". Communication positively influences the performance of fitness-specific activities, the genetic potential can be improved due to the interaction between practitioners. The present article aims to draw attention to the fact that the way people communicate is influenced, to a large extent, by the personality of the individual, with different interests and emotional states of their own, as well as the fact that their communication skills are essential in our society, they involve the transmission of data, by means of verbal or non-verbal signals, and the creation of different relationships between people. [6, 10]

Regarding sports activities in general and fitness in particular, socialization is a very good means of communication [4]. Fitness is a means of promoting fair play, a means of socialization, being considered a complex phenomenon with positive influences and effects, which is another aspect this article focuses on.

We also intend to emphasize that through socialization, athletes adopt certain rules and principles specific to society, then become members of a team, a group [9]. In the context of socialization, communication has a particularly important role, contributing to the integration and evolution of the athlete in society.

Keywords: *fitness, communication, soft skills, improvement, competition*

Rezumat

Comunicarea în domeniul sportului este un proces care îi preocupă foarte mult pe specialiști, iar informațiile legate de acest domeniu sunt foarte sărace. Jean Caune a subliniat faptul că "fenomenele culturale și procesele de comunicare fac parte, mai mult ca niciodată, din viața oricărei comunități"[3].

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Comunicarea influențează în mod pozitiv performanța activităților specifice fitness-ului, potențialul genetic poate fi îmbunătățit datorită interacțiunii dintre practicanți.
Articolul de față își propune să atragă atenția asupra faptului că modul de comunicare este influențat în mare măsură de personalitatea individului, care are diferite interese și stări emoționale proprii, precum și asupra faptului că abilitățile de comunicare sunt esențiale în societatea noastră, ele presupun transmiterea de date prin intermediul semnalelor verbale sau nonverbale, și crearea de diferite relații între oameni. [6, 10]
În ceea ce privește activitățile sportive în general și fitness-ul în special, socializarea este un foarte bun mijloc de comunicare [4]. Fitness-ul este un mijloc de promovare a fair-play-ului, un mijloc de socializare, fiind considerat un fenomen complex, cu influențe și efecte pozitive, un alt aspect pe care se concentrează acest articol.
De asemenea, ne propunem să subliniem faptul că prin socializare, sportivii adoptă anumite reguli și principii specifice societății, devenind apoi membri ai unei echipe, ai unui grup [9]. În contextul socializării, comunicarea are un rol deosebit de important, contribuind la integrarea și evoluția sportivului în societate.

Cuvinte cheie: *fitness, comunicare, abilități soft, îmbunătîțire, competiție.*

Introduction

Didactic communication is carried out between the coach and the athlete and involves the transmission of information specific to the educational process, but also the realization of collaborative, socio-affective, interpersonal relationships [13]. The coach takes into consideration the changes that occur in the behavior of athletes, aiming at a positive feedback in their attitude.

Sports specialists emphasize the feedback character of communication [5]. After transmitting the information by the subject, it acts on the receiver that will produce a feedback effect on the subject.

Another aspect specific to sports activities is the presence of non-verbal communication, which complements the verbal one. Among the most important aspects of non-verbal communication that we encounter in sports activities, we can highlight: the technique of carrying out a specific task, the reaction of the body, the attitude of athletes, the efficiency of accomplishment, the degree of fatigue, etc.

Case study on the soft skills in sports

Winning a sports trophy, something that many of us have always dreamed of, requires a lot of physical work, perseverance and courage [1]. However, becoming a legendary athlete requires another set of skills that we can use not only when we train for a competition, but also in our daily

lives. We will present a series of 6 soft skills that we have identified during our study, essential skills for an athlete when they set their goal to win a competition, but these skills can, in fact, turn into a lifestyle that helps us be much more organized and balanced [12].

Resistance

Every athlete knows that not every match or game in which he/she participates will be a victory. It may take some time, but endurance teaches athletes to accept that failure is not always something bad, it is part of life, and it teaches them not only to get back on their feet when life knocks them down, but also to encounter challenges and learn their lesson. Some of us need to learn certain lessons ”the hard way” [2]. Endurance helps us develop our ability to overcome fear and pull ourselves out of our comfort zones, something that can be applied to our daily lives.

Time management

In the same manner that the balance between personal and professional life can be challenging to accomplish in the real world, athletes must learn to cope with their time successfully. To know how to keep a balance between personal and professional life, training, press conferences, family, social life, all these require possessing well-developed time management skills [5].

Stress management

Nowadays stress affects everyone, more and more, we live our lives as in a whirlwind in which we strive to cope with all the challenges of life, to perform our work duties as well as we can, but also to have a balanced family life [7]. And all this can turn into stress in record time because it all takes our energy away and can lead to a decrease in our performance. Both inside and outside the gym, stress management is a skill that requires a lot of practice and self-control. Whether it is an important meeting or warming up for an important match, dealing with strenuous situations and calmly managing stressful situations is an important skill for everyone.

Communication

As in all types of industries, also in the sports industry the skill to communicate successfully with everyone involved in the communication process, from team members to managers or the media, is an essential skill. The way information is communicated determines the course of a subsequent situation, and in sports life it is exactly the same: the way a coach communicates the strategies and tactics of athletes or members of a team, since we also refer to team games, can make the difference between a successful performance and an unsuccessful one in a competition [10].

Teamwork

The skills related to an athlete practicing a certain type of team sport can easily be transferred to a person working as a member of a team in a company or institution. Team members need to know their strong points and weak points, transfer strategies, create new tactics and work together for a common aim. Success is always closer if members of one team manage to collaborate effectively.

Leadership skills

Whether we refer to a trainer training a large team or to a trainer training athletes individually, skills such as mentoring, delegation and making choices by identifying decisions are crucial leadership skills for any good trainer or manager [8]. And they can develop and improve over time depending on the situations we face, but also according to personal motivation.

Questionnaire applied to students studying physical education on the importance of soft skills

In order to determine how soft skills can positively influence sports performance or not, we applied the following questionnaire to 18 students of ”George Emil Palade” University of Medicine, Pharmacy, Science, and Technology, ”Petru Maior” Faculty of Sciences and Letters, Study Program Physical Education and Sports, study year 1 and 3:

1. *Specify the faculty/study program you are enrolled in.*
2. *Is fitness an activity appreciated and practiced by you?*
3. *How much time do you devote to practicing fitness?*
   30 min / day
   1 hour / day;
   2-3 hours / day
4. *What is the purpose of practicing fitness?*
   maintenance
   performance
   other (mention the purpose);
5. *Have you noticed an improvement in your health after practicing fitness?*
   Yes
   No
6. *Do you think that practicing fitness can improve informal/formal communication?*
   Yes
   No
7. *Do you consider that communication skills contribute to improving the sports performance you aim at by practicing fitness?*
   Yes
   No
8. *Is the information obtained through formal communication an advantage in practicing fitness?*
   Yes
   No
9. *Does informal communication stimulate you in carrying out sports/fitness activities?*
   Yes
   No
10. *Does achieving athletic performance pursued by practicing fitness help improve communication skills?*
    Yes
    No

And the results we have after the application of this questionnaire highlight the fact that communication skills are very important in practicing a type of sports because they can contribute to motivating athletes by providing supporting examples, to stimulate them for future competitions, but also to improve public speaking skills.

Results of the questionnaire

1. Specify the faculty/ study program you are enrolled in.

All eighteen students are enrolled in the study program Physical Education and Sports within ”George Emil Palade” University of Medicine, Pharmacy, Science, and Technology, ”Petru Maior” Faculty of Sciences and Letters, Târgu Mureș.

2. Is Fitness an activity appreciated and practiced by you?

Eighteen students out of eighteen gave an affirmative answer to this question.

3. How much time do you spend practicing fitness?

Six students spend thirty minutes a day practicing fitness, eleven students spend an hour a day practicing this type of sports, and only one student spends two or three hours a day practicing this activity.

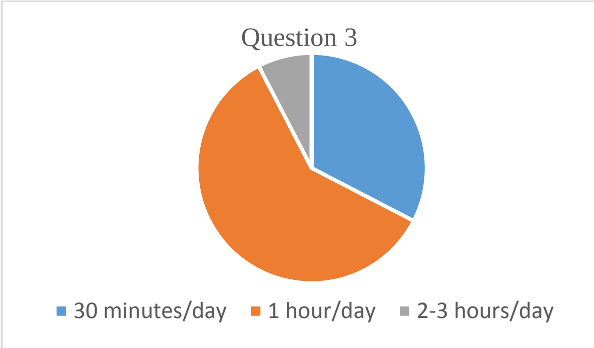

Figure 1:Time spend practicing fitness

4. What is the purpose of practicing fitness?

Fifteen students practice fitness with the aim of keeping fit and three students out of a total of eighteen practice this activity with the aim of obtaining performance.

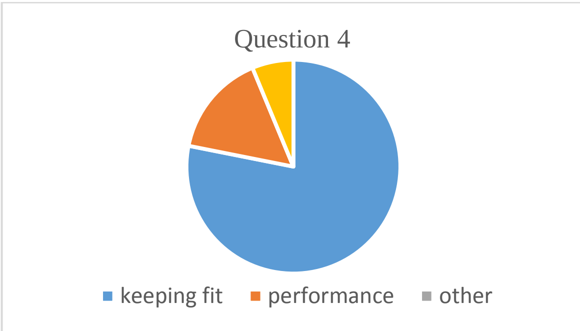

Figure 2:The purpose of practicing fitness

5. Have you noticed an improvement in your health after practicing fitness?

To this question all eighteen students offered an affirmative answer.

6. Do you think that by practicing fitness, informal/formal communication can be improved?

Seventeen students felt that practicing a certain type of sport, in our case fitness, helps improve informal/formal communication, and only one student felt that practicing fitness is not relevant to developing communication skills.

Figure 3:Improving formal / informal communication

7. Do you consider that communication skills contribute to improving the sports performance pursued by practicing fitness?

Seventeen students felt that communication skills contribute to improving athletic performance, and one student felt that practicing fitness is not necessarily closely related to developing this ability.

Figure 4:Improving the sports performance pursued by practicing fitness

8. Does the information obtained due to formal communication represent an advantage in practicing fitness?

Seventeen students out of a total of eighteen believe that the information obtained due to formal communication is an advantage in practicing a type of sports and only one student gave a negative answer to this question.

Figure 5:The information obtained due to formal communication in practicing fitness

9. Does informal communication stimulate you in carrying out sports/fitness activities?

To this question seventeen students offered a positive answer, which means that students communicate effectively with each other during sports trainings, moreover, such trainings represent a form of socialization for them. Only one student gave a negative answer to this question.

Figure 6:The way informal communication stimulates people in carrying out sports/fitness activities

10. Does achieving athletic performance obtained due to practicing fitness help improve communication skills?

For seventeen students, achieving the sports performance pursued through practicing fitness contributes to the improvement of communication skills, which means that they share their experiences from trainings and competitions, and this can only be rewarding and encouraging because we all need both examples in life and new communication strategies and sports performance.

Figure 7.The way achieving athletic performance obtained due to practicing fitness helps improve communication skills

Discussions

Lack of communication at an interpersonal level influences isolation, so we should not be surprised by the fact that so many people do not have friends and their social life does not offer them security.

Communication and movement are closely interrelated and are linked to the positive aspects of everyday life, as they can ensure our mental and physical comfort [9].

We consider that the importance of soft skills is not appreciated as it should be. People think they know how to communicate and that this ability comes naturally, but it is not always so.

A single word used inappropriately can change the whole interpretation of a certain situation. That is why soft skills should be taught accurately and practiced all the time.

Since they are the focus of our attention, we have looked for other studies as well, studies that highlight the importance of soft skills. And we have found the following comparison between soft skills and hard skills:

Hard skills	**vs.**	**Soft skills**
• Bilingual or multilingal		Integrity
• Database management		Dependability
• Adobe software suite		Effective communication
• Network security		Open-mindedness
• SEO/SEM marketing		Teamwork
• Statistical analysis		Creativity
• Data mining		Problem-solving
• Mobile development		Critical thinking
• User interface design		Adaptability
• Marketing campaign management		Organization
• Storage systems and management		Willingness to learn
• Programming languages (such as Perl, Python, Java, and Ruby)		Empathy
Hard skills are technical knowledge or training that you have gained through		Soft skills are personal habits and traits that shape how you

any life experience, including in your career or education.

work, on your own and with others [14]

And since we wanted to find opinions on how others regard the soft skills in comparison with hard skills in personal training, we have come across the following characteristics:

1. Motivating others
2. Empathy and compassion
3. Communication
4. Positivity
5. Self-development
6. Being friendly and approachable
7. Commitment and reliability
8. Creativity
9. Flexibility

And the last two features focus on the hard personal trainer skills:

10. Extensive fitness knowledge
11. Marketing skills [15]

Conclusions

While carrying out fitness training, different feelings and specific features of the individual (abilities), moods are communicated. By practicing fitness, the person will be able to master his/her feelings, the non-verbal communication being especially important.

Often, non-verbal language can influence the opponent, the movements and body positions, which are also called movement indicators, play a decisive role in sports activity.

Formal and informal communication is also particularly important in fitness training. Through communication, specific relationships are established between practitioners, relationships that can also produce strong motivations (better health, disease prevention, improving their own performance, increasing self-confidence, socialization, the desire to assert themselves in society).

Fitness can develop communication, but also different ways of relating between individuals, because sport can contribute to increasing self-confidence, to highlighting the human qualities and potential.

Bibliography

[1] Bassnett, S. (1997). Text Types and Power Relations, in Trosborg, A. (ed.) *Text Typology and Translation*, Amsterdam/ Philadelphia: John Benjamins

[2] Beeby, A. (2000). Evaluating the Development of Translation Competence, in Schäffner, C., Adab, B. (eds.), *Developing Translation Competence*, Amsterdam/ Philadelphia: John Benjamins

[3] Caune, J. (2000). *Cultură şi comunicare,* Bucureşti, Cartea Românească

[4] Dinu, M. (1997). *Comunicarea*, Editura Ştiinţifică, Bucureşti

[5] Ericson, P. M., Gardner, J. W. (1992). Two longitudinal studies of communication apprehension and its effects on college students' success, *Commun. Q.*, 40, 1992

[6] Mattelart, A., Mattelart, M. (2001). *Istoria teoriilor comunicării*, Iaşi, Editura Polirom

[7] Neubert, A. (2000). Competence in Language, in Languages and in Translation, in Schäffner, C., Adab, B. (eds.), *Developing Translation Competence*, Amsterdam/ Philadelphia: John Benjamins

[8] Nord, C. (2000). What do we know about the target text receiver?, in Beeby, A., Ensinger, D., Presas, M. (editors), *Investigating Translation*, John Benjamins Publishing Company, Amsterdam, pp 195-212

[9] Pop, C. R. (2014). *Comunicarea în educație fizică și sport,* Editura Prouniversitaria

[10] Slama – Cazacu, T. (2000). *Strategiile comunicaționale și manipularea,* Editura Polirom, Iași

[11] Şoitu, L. (1997). *Comunicare şi acţiune*, Institutul European, Iași

[12] Williams, T. R. (2005). Exploring the Impact of Study Abroad on Students' Intercultural Communication Skills: Adaptability and Sensitivity, *J. Stud. Int. Educ.*, 9

[13] Zlate, M. (1994). *Fundamentele psihologiei*, Editura Proumanitate

[14] https://www.indeed.com/career-advice/resumes-cover-letters/soft-skills?fbclid=IwAR3gEcP6YrncuvotuewgLtSRlk4P3wm-4DFvYVEcA024XGyRrMZBStOuaiM

[15] https://origympersonaltrainercourses.co.uk/blog/personal-trainer-skills?fbclid=IwAR2JhJHW_3RygiMauKhC7tgoeMtgE12EcLE2BYxs4ejm9cSAC58wVKZkxP4

INTRODUCTION OF SPECIFIC EXERCISES AND DIRECTED RECOVERY TECHNIQUES FOR IMPROVING EFFORT CAPACITY IN TRAINING OF ADOLESCENT BASKETBALL PLAYERS

INTRODUCEREA ÎN CADRUL ANTRENAMENTELOR A EXERCIȚIILOR SPECIFICE ȘI A UNOR TEHNICI DE REFACERE DIRIJATĂ PENTRU ÎMBUNĂTĂȚIREA CAPACITĂȚII DE EFORT LA ADOLESCENȚII CARE PRACTICĂ JOCUL DE BASCHET

***Adrian Iosif KOȘA*[1], *Adrian Titus SERSENIUC URZICĂ*[2], *Ilie Cristian COȘARCĂ*[3]**

Abstract

Aim: The aim of the study is to show the importance of introducing in training, of some effort exercises, as well as some recovery techniques (global postural exercises and relaxation techniques), in order to increase the effort capacity in adolescents which practices basketball. *Methods:* We included in the study a number of 27 subjects, aged between 14 and 18, who practice basketball, divided into 3 groups: a group that participated in the regular basketball training; a group that, in addition to the regular training, had complete an exercise program aimed to increase the effort capacity; and a group that, in addition to those specified in group 2, followed a recovery program that consisted of global postural exercises (Souchard Method) and Jacobson Relaxation Technique. The effort capacity was assessed by the Harvard Test and the Ruffier Index. *Results*: Group 2 and 3, which had specific exercises for effort training, had superior results compared to the first group, with a slight increase for Group 3, which shows the benefits of directed recovery to increase exercise capacity. *Conclusions*: The introduction of specific exercises increases the capacity of effort in adolescents who practice basketball, to a greater extent than in those who are provided in the training program only with elements of the game of basketball. In other words, the introduction of global postural exercises and relaxation techniques in addition to the exercises for the increase of the effort capacity, determines a positive influence on the efficiency to effort of the adolescents practicing basketball.

Keywords: *basketball, effort, guided recovery, adolescents*

Rezumat

Scop: Scopul studiului este de a arăta importanța introducerii în cadrul antrenamentelor, a unor exerciții de efort, precum și a unor tehnici de refacere (exerciții posturale globale și

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tehnici de relaxare), în vederea creșterii capacității de efort la adolescenții care practică jocul de baschet. *Metode:* Au fost incluși în studiu un număr de 27 de subiecți, adolescenți, cu vârste cuprinse între 14 și 18 ani, care practică baschetul, împărțiți în 3 loturi: un lot care a participat la antrenamentul de baschet propriu-zis, un lot care a urmat pe lângă antrenamentul propriu-zis și un program de creștere a capacității de efort și un lot care pe lângă cele specificate la lotul 2 a urmat și un program de refacere ce a constat în exerciții posturale globale (metoda Souchard) și de relaxare (Tehnica Jacobson). A fost evaluată capacitatea de efort prin proba Harvard și indicele Ruffier. *Rezultate*: Lotul 2 și 3, care au avut exerciții specifice pentru antrenamentul la efort, au avut rezultate superioare față de primul lot, cu un ușor plus pentru lotul 3, ceea ce arată beneficiile refacerii dirijate pentru creșterea capacității de efort. *Concluzii*: Introducerea unor exerciții specifice de efort determină creșterea capacității de efort la adolescenții care practică baschetul în mai mare măsură decât la cei la care sunt prevăzute în programul de antrenament doar elemente din jocul de baschet. Într-o altă ordine de idei, alocarea pe lângă exercițiile de creștere a capacității de efort și a unor exerciții postural globale și a unor tehnici de relaxare determină o influență pozitivă asupra randamenrului la efort a adolescentului practicant al baschetului

Cuvinte cheie: *baschet, capacitate de efort, refacere dirijată, adolescenți*

Introduction

For most people who practice, sport is a "way of life" meant to ensure that the person has a certain state of mind, which is generally in line with physical and mental health, safety and self-control, perseverance, etc. Of course, practicing the sport from an early age, in an organized setting, will be an important aspect for the future adult for its further development. Team sports, in general, are more attractive than individual sports, and lately more and more children and young people are attracted to basketball.

The practice of basketball, like other sports, requires the development of motor capacities, and along with them, it is especially important to improve the effort capacity, which, developed during childhood, will provide, later, a good adaptation of all organs and systems (especially cardiovascular) at different types of effort. This is also supported by Mogoș (1990) who says that "sustained physical activity has beneficial consequences on the cardiovascular system, namely: it decreases the workload of the heart and improves its energy metabolism; reduces blood pressure values; improves the degree of exercise tolerance of the individual; it increases the individual's degree of independence of movement and increases his desire for life [1]. Kallos and Tache (2013) also state that in modern basketball, it is necessary to increase the speed of movement and execution, so that there is fatigue of the central nervous system, which is characterized by decreased ability to concentrate and myoarthrokinetic overload. In order to meet these demands, it is absolutely necessary to improve the capacity for effort. [2]

From another point of view, during adolescence, when the capacity for effort is still reduced and the myoarthrokinetic system is not yet mature, it is necessary to introduce elements of directed recovery (along with spontaneous recovery) of the body. "Restoration means the component part of the training process that brings together all the natural or artificial means used to accelerate the processes of rebalancing the body's homeostasis [3]. Drăgan, quoted by Șufaru (2008) says that "directed recovery is that component part of the training, which uses some natural or artificial physiological means directed, coming from the internal or external environment, in order to restore homeostasis and even overcome this threshold by overcompensating”[4]. In the same context, Șalgău and Mârza quoted by Șufaru (2008) say that “this type of recovery cannot replace, but completes, compensates and accelerates the natural recovery of the organism”[5].

Material and methods

Subjects

The study was conducted on 27 subjects, divided into 3 groups (1, 2 and 3), aged between 14-18 years, following a program of 3 weekly basketball training sessions for 3 months.

Group 1 followed only basketball training, and in groups 2 and 3, in addition to the specific elements of the basketball game, we introduced an exercise program for 3 months to improve the effort capacity. In addition, group 3 also benefited from global postural exercises 3 times a week (Souchard method), as well as an effort relaxation technique (Jacobson technique - short form of 30 minutes) once a week.

Table no.1. Subject data (age, height, weight)

Groups	**Age**	**Height**	**Weight**
Group 1	16.11 ± 1.45	1.78 ± 0.09	76.11 ± 11.83
Group 2	16.32 ± 1.39	1.81 ± 0.07	76.00 ± 12.73
Group 3	16.00 ± 1.50	1.76 ± 0.07	72.44 ± 8.57

The patient groups were selected from the “Constantin Șerban” Theoretical High School of Aleșd being homogeneous in terms of age, height and body weight.

Assessment

In conducting the study, we evaluated the exercise capacity through 2 tests, namely Harvard Test (maximal test) and Ruffier Index (submaximal test).

At the *Harvard test* - the subject performs ascents and descents on the exercise ladder at a rate of 30 times per minute (1 second ascent, 1 second descent), in the rhythm of the metronome. This rhythm must be maintained for a period of 5 minutes timed by the examiner. In the first 30 seconds after the end of the effort, the pulse is measured and marked with P1. In the first 30 seconds of the second minute after the test, the pulse is measured again and marked with P2. In the first 30 seconds of the third minute after the end of the effort, the pulse is measured for the last time and is marked with P3.

The physical fitness index is calculated according to the following formula:

Physical fitness index = [T (effort time / sec) x 100] / [(P1 + P2 + P3) x 2]. [6]

Table no. 2. Harvard test interpretation

Value (physical fitness index)	**Qualifying**
Over 90	Excellent physical condition
80-90	Good physical condition
55-79	Average physical condition
Under 55	Poor physical condition

In the case of the *Ruffier index* - measure the pulse in the sitting position and mark it as P1. The subject performs 30 squats in 45 seconds. In the first 15 seconds after the end of the effort, the pulse is measured, the subject being supine, and the value obtained is related to 60 seconds and is marked with P2. After a minute of rest in supine, the pulse is measured again and marked with P3.

The Ruffier index is calculated according to the following formula:

Ruffier Index = [(P2 - 70) + (P3 - P1)] / 10. [7]

Table no. 3. Interpretation of the Ruffier Index

Value (Ruffier index)	**Qualifying**
0 - 2.9	Good index
3-6	Medium index
Over 6	Deficit index

Results

In the Harvard Test, in the initial testing, the 3 groups had a close average of the effort capacity, with a plus for Group 1 in which the average was 76.24 ± 6.34, compared to 73.18 ± 7.18 in Group 2 and 74.06 ± 7.63 in Group 3. Referring to the grade of the test, all 3 groups were initially classified as "average physical condition", between 55 and 79 points.

In the final assessment, the changes in fitness index tested by the Harvard Test were positive in all groups, but in Group 1 it increased to 76.36 ± 6.07, compared to Group 2 where the increase was 78.46 ± 7.83, and in Group 3 at 80.08 ± 7.46. At the end of the 3 months, Group 3 was in "good physical condition", 80.08 ± 7.46, the other 2 groups remaining in "average physical condition", with a slight improvement for Group 2 where the increase was 5.71 ± 3.19, compared to only 0.21 ± 2.47 in Group 1. (table no. 4, figure 1)

Table no. 4. Harvard Test results

Group	**Initial**	**Final**	**Progress**
Group 1	76.24 ± 6.34	76.36 ± 6.07	0.21 ± 2.47
Group 2	73.18 ± 7.18	78.46 ± 7.83	5.71 ± 3.19
Group 3	74.06 ± 7.63	80.08 ± 7.46	6.36 ± 2.61

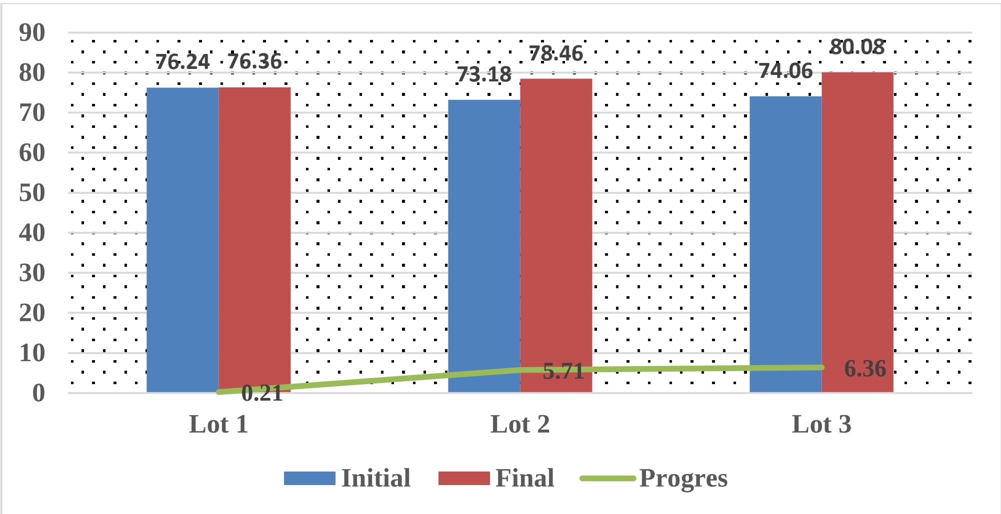

Figure 1. Harvard Test results

The Ruffier Index shows the same tendency to increase the effort capacity higher in Group 3 compared to Group 2, as well as those of Group 2 compared to Group 1. Thus, even if the interpretation scale of the Ruffier Index includes the 3 groups in the average index (between 3 and 6) in both evaluations, however, in the final evaluation, the progress rate was 2.16 ± 0.92 in Group 3, 1.89 ± 0.67 in Group 2 and only 0.63 ± 0.90 for Group 1. (Table 5)

Table no. 5. The results of the Ruffier Index

Group	Initial	Final	Progress
Group 1	4.69 ± 2.69	4.40 ± 1.29	0.63 ± 0.90
Group 2	5.96 ± 1.40	4.07 ± 1.28	1.89 ± 0.67
Group 3	5.69 ± 1.51	3.53 ± 1.46	2.16 ± 0.92

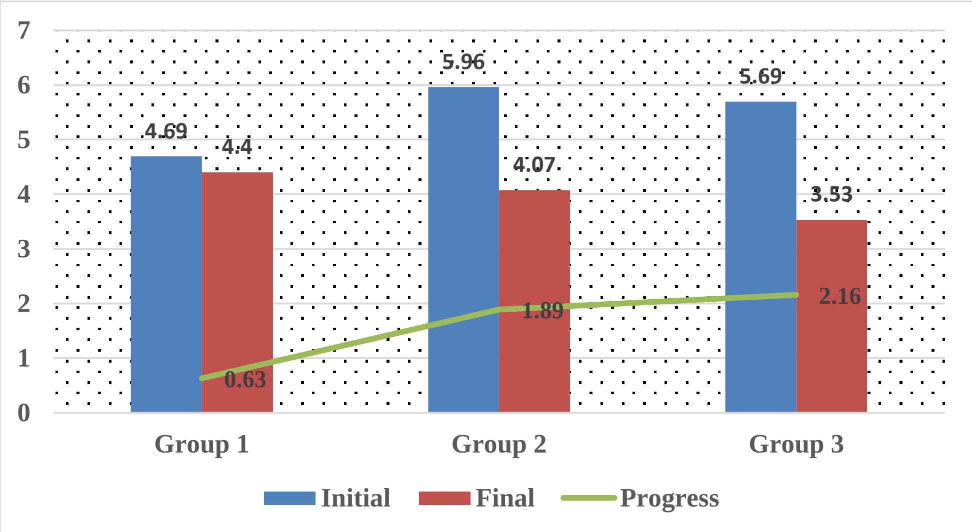

Figure 2. Ruffier index results

Discussions

The game of basketball, as an alternative of practicing exercise in an organized and attractive way for children and adolescents (especially in the current era, dominated by computer and video games), assumes the improvement of motor capacities and effort capacity, as well as an effective dosage of training intensity. This is also stated by other researchers who, in order to improve the posture, coordination and other motor capacities, recommend non-specific means of basketball, which have finally led to progress in practicing this sport [8].

The increase in exercise capacity is influenced by the practice of a sport, a fact highlighted by Crăciun et all. (2008) who states that "physical activity contributes to the development and improvement of vital capacity and endurance, the rate of progress being much higher. great for sporty kids [9]. However, in teams of athletes who practice a particular sport, the increase in effort capacity is also conditioned by specific exercises to improve it. Thus, the study we conducted indicates that the introduction of exercises that increase exercise capacity are beneficial, so that in groups 2 and 3 the results are superior to group 1. Probably, if the study had been extended over time, these results would have been even more obvious. Also, the introduction of global postural exercises (which maintain a balanced level of muscle tone between agonist and antagonist muscles, between the phasic and tonic muscles) and general relaxation techniques (Jacobson technique), have contributed to a positive adjustment of the response to the increase of the effort capacity. This is also confirmed by a study conducted by Chiriac PB, Mihăilescu L and Bărbăcioru C., which used the Yumeiho technique as a means of relaxation and recovery of the body after exertion. They say the use of the Yumeiho technique accelerates the ability to recover overall after effort. [10]

Conclusions

The introduction of specific exercises increases the capacity of effort in adolescents who practice basketball, to a greater extent than in those who are provided in the training program only with elements of the game of basketball. In other words, the introduction of global postural exercises and relaxation techniques in addition to the exercises for the increase of the effort capacity, determines a positive influence on the efficiency to effort of the adolescents practicing basketball.

Bibliography

[1] Mogoș, V. (1990). Inima și efortul fizic, *Editura Sport-Turism*, București
[2] Kallos, C., Tache, S. (2013). Anthropometric indicators and aerobic exercise capacity in young basketball players, *Palestrica of the third millennium – Civilization and Sport*, Vol. 14, no. 3, July-September
[3] Neferu, F. (2015). The importance of exercice capacity recovery in obtaining performance in sports”, *Studia Universitaris ”Vasile Glodiș”, Seria Educație Fizică, Sport și Kinetoterapie*, Arad, Volumul 4
[4] Șufaru, C. (2008). Studiu asupra refacerii organismului în jocul de handbal la echipele de seniori, *Gymnasium*, nr. 12, anul IX
[5] Șufaru, C. (2008). Studiu asupra refacerii organismului în jocul de handbal la echipele de seniori”, *Gymnasium*, nr. 12, anul IX
[6] Tarcău, E., Chiriac, M. (2015), *Măsurare și evaluare în kinetoterapie – Note de curs*, Editura Universității din Oradea
[7] http://www.fizioms.ro/edu/lp/data/Probele_de_efort.pdf - octombrie 2021
[8] Tarcău, E., Ciordaș, A., Boca, I.C. (2015). Studiu privind îmbunătăţirea coordonării mişcărilor, la tinerii cu vârste cuprinse între 14 şi 18 ani care practică baschetul, *Revista Română de Kinetoterapie*, Nr. 36
[9] Crăciun, D.D., Tache, S., Bocu, T. (2008). Physical training and exercise capacity in children – beginner football players, *Palestrica Mileniului III – Civilizaţie şi Sport*, Volumul IX, Nr. 3 (33)
[10] Chiriac, P.B., Mihăilescu, L., Bărbăcioru, C. (2021). Evaluation of lactic acid anaerobic effort capacity recovery through the association of Yumeiho therapy with other means of recovery, *Journal of Physical Education and Sport (JPES)*, Vol. 21 (1), Art 430