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Ultrasonographic evaluation of transverse abdominal muscle thickness and quality of life in patients with osteoarthritis of the large joints depending on age

Ocena ultasonograficzna grubości mięśnia poprzecznego brzucha oraz jakości życia u chorych z chorobą zwyrodnieniową dużych stawów w zależności od ich wieku

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Key words
eldery people, quality of life, TrA muscle, deep muscle training

Abstract
Introduction: The aim of the study was to evaluate quality of life and changes in transverse abdominal muscle thickness depending on the age of patients' subjected to physiotherapy with elements of central stabilisation.
Material and methods: The study involved 35 persons divided into 2 groups: under the age of 60 (n=16, mean age 43 ± 12) and above 60 (n=19, mean age 68 ± 5 years) treated at the Whole-body Rehabilitation Unit. The aim of hospitalisation was to rehabilitate large joints in the course of osteoarthritis. All those involved in the study assessed the quality of life subjectively using the SF-36 questionnaire; ultrasound evaluation of transverse abdominal muscle thickness (TrA) was performed, and additionally, activation ratio and percentage changes in muscle thickness were determined.
Results and conclusions: In the group of patients above the age of 60, the average difference in thickness of the muscle (TrA) measured between rest and contraction was 0.07±0.06 mm in exam 1, and 0.06 ±0.05 mm in exam 2. In the assessment of quality of life, the patients obtained the mean score of 103.5 ± 16.08 points and after the physiotherapy, the mean score was 93.4 ± 17.2 points. In the group of people below the age of 60, in exam 1, the average difference in the thickness of the TrA muscle measured between rest and contraction was 0.08 ± 0.06 mm and in exam 2, 0.09 ± 0.06 mm. In the assessment of quality of life, patients received an average score of 91.8 ±26.7 points in exam 1, and 86.1 ± 28.19 points in the second one. After the application of the physiotherapy programme with elements of deep muscle training, quality of life improved significantly in both groups. The TrA muscle thickness changed positively, especially in the group of people age 60 and above.

Słowa kluczowe
osoby starsze, jakość życia, USG m. TrA, trening mięśni głębokich

Streszczenie
Wstep: Celem pracy była ocena jakości życia oraz zmian grubości mięśnia poprzecznego brzucha w zależności od wieku u osób poddanych fizjoterapii z elementami stabilizacji centralnej.

The individual division of this paper was as follows: a – research work project; B – data collection; C – statistical analysis; D – data interpretation; E – manuscript compilation; F – publication search

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Materiał i metody: W badaniu wzięło udział 35 osób podzielonych na dwie grupy: poniżej 60 roku życia (r.ż.) (n=16, średnia 43 ±12 lat) oraz powyżej 60 r.ż. (n=19, średnia 68 ±5 lata) leczonych na Oddziale Rehabilitacji Ogólnoustrojowej. Celem hospitalizacji była rehabilitacja w przebiegu choroby zwyrodnieniowej dużych stawów. Wszyscy włączeni do badania oceniali subiektywnie jakość życia za pomocą kwestionariusza SF-36, dokonano ultrasonograficznej oceny grubości mięśnia poprzecznego brzucha (TrA), dodatkowo wyznaczono współczynnik aktywacji oraz procentowe zmiany grubości mięśnia.
Wyniki i wnioski: W grupie chorych powyżej 60 r.ż. w badaniu I średnia różnica w grubości mięśnia TrA mierzona między spoczynkiem, a skurczem wyniosła 0,07 ±0,06 mm., w II badaniu 0,06 ±0,05 mm. W ocenie jakości życia pacjenci uzyskali średni wyniki 103,5 ±16,08 pkt. a po zastosowanej fizjoterapii średni wynik wyniósł 93,4 ±17,2 pkt. W grupie osób poniżej 60 r. ż. w I badaniu średnia różnica w grubości mięśnia TrA mierzona między spoczynkiem a skurczem wyniosła 0,08 ±0,06 mm a badaniu II 0,09 ±0,06 mm. W ocenie jakości życia pacjenci uzyskali średni wynik 91,8 ±26,7 pkt. w I badaniu a w kolejnym 86,1 ±28,19 pkt. Po zastosowaniu programu fizjoterapii z elementami treningu mięśni głębokich w obydwu grupach badanych jakość życia uległa wyraźnej poprawie. Korzystnie zmieniła się grubość mięśnia TrA, szczególnie w grupie osób powyżej 60 r.ż.

INTRODUCTION

Quality of life is an inseparable component of human life, particularly in the case of those middle-aged and seniors. Along with age, there is a decrease in physical activity and self-evaluation of health. Aging is a common phenomenon, accompanied by an increased risk of numerous diseases and related disabilities, as well as reduced ability to function in society[1,2]. Undoubtedly, illnesses, symptoms and accompanying ailments have significant impact on a human being's ability to function properly physically, mentally and socially. Quality of life associated with the state of health has become a determinant regarding the effectiveness of an implemented treatment process. In medical science, in the last three decades, there has been a significant increase in the interest and use of quality of life mechanisms to assess health state and treatments used in many diseases[3,4]. In middle-aged individuals and the elderly, there is, inter alia, a deterioration of stability. Changes in body posture, deterioration of proprioceptor functioning and sense of balance also become an inseparable element of involutional changes taking place within the body. The reduction in muscle strength slows down dynamics of muscle strength increase, which in turn, leads to reduced functioning. Constantly deteriorating motor control is the cause of falls, fractures and limitations in independence[2,3,4].

In recent years, the concept of central stabilisation has become a very popular form of physiotherapeutic treatment for people with motor system dysfunctions. It refers to the efficiency and neuromuscular control necessary to maintain functional stabilisation of the lumbar-pelvic-iliac complex[5].

Stability can be ensured by active posture regulation through the posture adjustment system – proper interaction of the vestibular, visual and proprioceptive systems. Postural stability deterioration along with age is the result of motor and postural system impairment[6]. Insufficient stabilisation and postural control of the trunk caused by the lack of deep muscle activity may result in deterioration of movement efficiency as well as increased pain in the spinal and peripheral joints. In recent years, the role of deep muscle stabilisation training has become the subject of interest for many researchers[7]. Re-education of motor control enables the reproduction of correct movement patterns during activation and integration on many levels of the central nervous system (CNS)[8]. The results of studies conducted by numerous authors indicate the role of central stabilisation and motor control in the initiation of functional movements, which is particularly important in the physical therapy of patients with motor organ dysfunctions[9,10]. In the light of these facts, in the process of rehabilitation of patients with musculoskeletal system dysfunctions, focus should be put on deep muscle activation with regard to improving movement quality via motor control re-education.

STUDY AIM

The aim of the study was to assess quality of life and changes in transverse abdominal muscle (TrA) thickness among people undergoing physiotherapy with elements of central stabilisation. The following research questions were posed:

1. Does and how does the physiotherapy programme with elements of deep muscle training affect quality of life?
2. Are there any changes in the thickness of the TrA muscle after the applied physiotherapy programme with elements of deep muscle training, evaluated during ultrasound examination?
3. Does age affect the percentage change in TrA muscle thickness after undergoing the physiotherapy programme with elements of deep muscle training?

MATERIAL AND METHODS

Characteristics of the study group

The study included 35 participants divided into 2 groups: under the age of 60 (n = 16, mean 43 ± 12 years) and above the age of 60 (n = 19, mean 68 ± 5 years) treated at the Department of Systemic Rehabilitation of the 5th Military Hospital with Polyclinic, Independent Public Health Care Centre (SP ZOZ) in Krakow. The purpose of hospitalisation was rehabilitation in the course of osteoarthritis of the large joints. The inclusion criteria were: lack of abdominal cavity surgery, logical verbal contact, allo- and autopsychic level of patients with a minimum of 7 points from the Short Portable Mental Status Questionnaire according to Pfeiffer-SPMSQ as well as informed consent to participate in the proposed study. The study was planned and carried out in accordance with the Declaration of Helsinki. The participants of the study were informed verbally and in writing about all the procedures and gave their informed consent to participate in the research. Funds for the purchase of equipment were obtained from the Statutory Research Project of the University of Physical Education in Krakow No. 86/BS/KRK/2016.

RESEARCH METHODOLOGY

All subjects included in the study subjectively assessed quality of life using the SF-36 questionnaire. Ultrasonographic evaluation of transverse abdominal muscle (TrA) thickness was performed. The test was always performed by the same examiner with the same ultrasound device in order to minimise measurement error. All subjects underwent a 3-week physiotherapy programme including central stabilisation exercises. The tests were performed twice – after admitting the patient to the hospital ward and after three weeks of therapy.

The SF-36 (Short Form of Health Status Questionnaire) assesses quality of life by answering 11 closed questions, which contain 36 statements about well-being in terms of 8 health components, divided into: physical component (physical functioning, limitations related to physical well-being, pain, general health) and the psychological component (limitations caused by emotional well-being, vitality, emotional welfare and social functioning). The quality of life indicator is the sum of points from all 8 areas of quality of life and enables overall assessment of state of health. According to the Polish version of the questionnaire, the highest point value means the lowest degree in assessing quality of life, while the lowest point value means the highest level of quality of life. The maximum number of points on the quality of life index is 171[11].

Rehabilitative Ultrasound Imaging-RUSI of the transverse abdominal muscle (TrA) was performed using the Mindray DP 50 apparatus with a linear wand.

The initial position of the patients was supine with the lower limbs bent in the hip and knee joints, with the feet resting on the base to loosen the abdominal wall. The probe emitting the image of the examined TrA muscle was placed medially with respect to anterior superior iliac spine. In order to unify muscle measurements, 3 cm from the anterior superior iliac spine were measured in a medial direction. Then, at the appropriate depth of occurrence of the muscle, its thickness was measured. The thickness of the muscle during rest was assessed while the subject breathes freely. Thickness measurements were performed at the time of activation, after contraction, during active, maximal abdominal exhaling. Before the actual measurement, each of the subjects performed several instructional trials observing the image on the ultrasound monitor.

The measurements also made it possible to determine the activation ratio (1) and the percentage change in muscle thickness (2) according to the formulas[12]:

(1) Activation ratio = muscle thickness during contraction / muscle thickness at rest,

(2) Percentage of muscle size change = (muscle thickness during contraction - muscle thickness at rest) / muscle thickness at rest.

The applied 3-week training plan together with patient education was divided into 2 stages. The first (lasting up to 7 days) included learning how to assume proper initial position, proper breathing control and correct and conscious activation of deep spine stabilisers. Simple exercises inducing contraction of the transverse abdominal muscle were also taught. The second stage consisted in using the learned positions to perform more difficult exercises in order to stimulate the transverse, multifidus and oblique abdominal muscles. In the exercises, different starting positions were used: standing, supported kneeling, supine, lying on one's side, sitting on a Swiss ball.

Statistical analysis was performed using the MS EXCEL 2016 Analysis ToolPak and the Statistica 13 programme. The results are presented in the form of arithmetic means together with the standard deviation for the 95% confidence interval. Statistical significance was assumed at a level of p below 0.05. Differences between individual exams in the group and between groups were checked using the t test.

RESULTS

In the group of patients above the age of 60, in the 1st exam, the mean thickness of the TrA muscle at rest was 0.47 ± 0.18 mm, while during contraction, it totalled 0.39 ± 0.15 mm. The mean difference in muscle thickness, TrA measured between rest and contraction, was 0.07 ± 0.06 mm. The activation ratio determined on the basis of the performed measurements was, on average, 0.85 ± 0.09. In turn, the average percentage change in the thickness of the TrA muscle was 18.5%. In the assessment of quality of life, patients achieved average scores of 103.5 ± 16.08 points. After the therapy, a 2nd examination was performed in which the average thickness of the TrA muscle at rest was 0.43 ± 0.15 mm and during contraction, 0.39 ± 0.15 mm. In turn, the average difference in the thickness of the examined muscle measured between rest and contraction was 0.06 ± 0.05 mm. The determined activation ratio was 0.86 ± 0.07. On the other hand, the percentage change in TrA muscle thickness for the 2nd exam was 13.7%. The average quality of life assessment was 93.4 ± 17.2 points. Only in terms of quality of life assessment were there great statistically significant differences between the two exams ($p < 0.01$). In addition, measurements were also performed for differences between the thickness of the muscle at rest

Table 1

Basic statistics for TrA muscle and quality of life measurements

TrA muscle	Patients > age 60			Patients < age 60			*p* > 60 age / < 60 age
	Exam 1	Exam 2	*p*	Exam 1	Exam 2	*p*	
Muscle thickness at rest [mm]	0.47 ±0.18	0.43 ±0.15	>0.05	0.42 ±0.16	0.40 ±0.12	>0.05	>0.05
Muscle thickness during contraction [mm]	0.39 ±0.15	0.37 ±0.12	>0.05	0.34 ±0.12	0.31 ±0.08	>0.05	>0.05
Difference in muscle thickness rest – contraction [mm]	0.07 ±0.06	0.06 ±0.05	>0.05	0.08 ±0.06	0.09 ±0.10	>0.05	>0.05
Activation ratio	0.85 ±0.09	0.86 ±0.07	>0.05	0.83 ±0.10	0.81 ±0.17	>0.05	>0.05
Percentage change in muscle thickness [%]	18.5 ±0.37%	13.7 ±0.07%	>0.05	17±0.1%	19 ±0.17%	<0.001	<0.001
Quality of life assessment [pts]	103.5 ±16.08	93.4 ±17.20	<0.01	91.8 ±26.70	86.1 ±29.19	>0.05	>0.05

Table 2

Correlations between TrA muscle thickness measured at rest and tested parameters in both age groups

Tested parameters of TrA muscle	Exam 1		Exam 2	
	TrA muscle thickness at rest group < age 60	TrA muscle thickness at rest group > age 60	TrA muscle thickness at rest group < age 60	TrA muscle thickness at rest group > age 60
TrA muscle thickness during contraction	0.95*	0.94*	0.54	0.94*
TrA muscle activation ratio	- 0.47	- 0.34	- 0.65*	- 0.36
Percentage change in thickness of TrA muscle	- 0.47	0.27	- 0.65*	- 0.36
Quality of life assessment	- 0.09	- 0.26	- 0.19	0.06
Difference in thickness between rest and contraction	0.83*	0.65*	0.75*	0.70*

* *p*<0.05

in both exams, which amounted to an average of 0.03 ± 0.11 mm, and at rest, 0.02 ± 0.09 mm. However, these comparisons were not statistically significant.

In the group of patients below the age of 60, in the 1st exam, the average thickness of the TrA muscle at rest was 0.42 ± 0.16 mm, while during contraction, it totalled 0.34 ± 0.12 mm. The average difference in TrA muscle thickness measured between rest and contraction was 0.08 ± 0.06 mm. The activation ratio determined on the basis of the taken measurements was, on average, 0.83 ± 0.1. In turn, the average percentage change in the thickness of the TrA muscle was 17%. In the assessment of quality of life, patients obtained average results of 91.8 ± 26.7 points. In exam 2, the average thickness of the TrA muscle at rest was 0.40 ± 0.12 mm and during contraction, 0.31 ± 0.08 mm. In turn, the average difference in the thickness of the examined muscles measured between rest and contraction was 0.09 ± 0.10 mm. The determined activation ratio was 0.81 ± 0.17. In turn, the percentage change in the thickness of the TrA muscle in the 2nd exam was 19%. The average quality of life assessment equalled 86.1 ± 28.19 points. Only in the range of percentage changes in muscle thickness were there highly statistically significant differences between the two tests ($p < 0.0001$). Differences between the thickness of the muscle at rest and contraction in both exams were 0.02 ± 0.11 mm and 0.03 ± 0.13 mm, respectively. Nonetheless, these comparisons were not statistically significant (Table 1). When comparing both groups of patients, statistically significant changes were only noted in the percentage of TrA muscle thickness at the level of $p < 0.001$.

In the 1st exam, a significant, strong and positive correlation was observed in the group of patients below 60 years of age between the thickness of the TrA muscle measured at rest and the thickness of the muscle in contraction, r = 0.95. Also in the above-60 group of patients, the same correlation was observed for r = 0.94. The increase in thickness of the TrA muscle at rest led to an increase in the measurement of the TrA muscle during contraction. In addition, in the group of patients below 60, there was a significant, strong and positive correlation (r = 0.83) between TrA muscle thickness at rest, and the difference in muscle thickness measured between rest and contraction. The same relationship occurred in the group of patients above the age of 60, however, it was moderate and totalled r = 0.65. The remaining parameters did not significantly correlate with TrA muscle thickness at rest.

In turn, in the 2nd exam, only in the group of patients above 60 was there a significant, strong and positive correlation between TrA thickness at rest and its thickness during contraction. In the group of patients under 60 years of age, however, after the intervention, significant, moderate and negative correlations were observed (r = -0.65) between the thickness of the TrA muscle at rest, the activation ratio and the percentage change in muscle thickness. Thus, a decrease in the thickness of the muscle led to a decrease in the ratio of activation of the contraction, as well as a reduction in the percentage change of its thickness. In both groups, in the 2nd exam, there was a significant, strong and positive correlation between the thickness of the TrA muscle at rest and the difference in the thickness of the muscle measured between rest and contraction - patients below the age of 60: r = 0.75, above 60: r = 0.70.

The remaining parameters did not significantly correlate with the thickness of the TrA muscle at rest, and Table 2 presents the comparative results of all correlational results between TrA muscle thickness and the remaining TrA parameters tested.

DISCUSSION

In the scientific literature, there is a term called positive aging, also known as successful aging, contrasting with ordinary aging. According to this concept, there are 3 key elements necessary for positive aging: low probability of diseases and related disability (avoidance of diseases and disability), maintaining high physical fitness and cognitive functions, and active involvement in social life, including the maintenance of creativity and productivity[13].

According to Szewczak et al.[14], the assessment of quality of life among older people should take various aspects related to health and physical and psychological well-being into account as well as the indicators of social functioning. It is this information that reflects the sense of happiness, cognitive functioning, view of oneself, coping with changes and limitations of the body, social comparison, positive attitude, determination, which, in turn, are a reflection of the extent of necessary support[14]. The aging process is time-wise and dynamic. It is characterised by the deterioration of life functions in biological, psychological and social aspects. Due to the natural, irreversible and increasing changes in the metabolic and physicochemical properties of cells, there is impairment of self-regulation, adaptation, repair and reproductive capacity, adaptation of the body to internal and external environmental changes and innate or acquired physical cellular and humoral defensive mechanisms[15]. According to Kowalik et al.[16], a holistic model of care demands a comprehensive look at the aging society while taking their subjective feelings into account. This entails a growing interest in the quality of life of older people. Introduction of the study on quality of life among patients resulted in the interest of health care professionals regarding improvement of functional capacity, eliminating mental suffering and creating a friendly environment[16].

The effects of an aging population are a huge challenge for medicine, especially rehabilitation. The main problems of old age are limitations in the ability to perform everyday activities, balance and independent walking disorders. These disorders are the result of involution processes and are often a symptom of diseases that certainly affect quality of life[13].

In the presented research, the standardised SF-36 questionnaire was used to assess quality of life. Both the physical and mental sphere of the elderly, were evaluated. In both age groups, improvement was noted in the 2nd exam after treatment. In people above the age of 60, statistically significant differences between the two exams were obtained. Kalfoss and Halvorsrud[17] examined 379 people, citizens of Norway aged 65 and above. As shown by the results, the greatest impact on the subjective quality of life regards: the ability to perform everyday activities, mobility, sensory efficiency, being healthy, home environment. Sex life had the least influence. In addition, the authors examined the relationship between age, gender, material status and assessment of the quality of life. In the group of people aged 75 and below, the most important were: positive self-perception, ability to acquire new skills and sex life, which turned out to be more important than for the older group. Subjects 75 and older paid more attention to not feeling pain. There was also a difference in the perception of the quality of life among women and men. Women attached greatest importance to such factors as: sensory efficiency, relationships with others, the ability to learn and memorise important information, a positive attitude towards death and dying, personal beliefs, the ability to participate in social life, the ability to think about everyday problems and make decisions, body image and appearance. For men, not to experience pain and sexual life were of significance. Both men and women rated the ability to perform everyday activities the highest, and then, the possibility of independent movement and health[17].

Al-Windi et al.[18] also studied the influence of age, gender and socio-demographic variables on the assessment of the quality of life among elderly people and noted that in men, assessment of successful aging is evaluated relatively higher than in the studied women[18]. Different results were obtained by Kurowska and Kajut[19], indicating the lack of connection between gender, age and individual areas of quality of life and the functioning of subjects. The authors of this work take into account the future extension of research with regard to the division into sex.

Motor control, which is responsible for planning and conducting motor strategy with age, deteriorates, radically changing the quality of movement. Insufficient stabilisation and postural control of the trunk caused by the lack of deep muscle activity may result in the deterioration of movement efficiency as well as increased spinal and joint pain. Deep muscles perform the function of local stabilisers, which in both static and dynamic conditions are responsible for active stabilisation of the lower trunk and spine as well as the base for proper circumferential mobility[20]. The movement is initiated in the centre and then transferred to the limbs[21]. Within the context of dynamic stabilisation, we are talking about the ability to use force and endurance in a functional manner within all planes of motion, regardless of the position of the body's centre of gravity[22]. Research on involutional changes shows that after exceeding the age of 45, muscle mass decreases by an average of about 6% per decade[23].

Changes in the aging process mainly concern fast-contracting fibres with glycolytic metabolism subtype IIb[24]. These fibres are susceptible to fatigue, thus with age, the possibility to perform great efforts in a short period of time decreases. Changes in rapidly contracting IIa fibres with oxy-glycolytic metabolism come later and are less intense. Type I fibres, i.e. slowly contracting fibres, having oxygen metabolism, do not undergo significant changes until a later age, which means that one of the typical features of the muscle aging process is the predominance of this type of fiber[25]. The main feature of the deep muscles is the content of slowly contracting, low-threshold units. This fibre are resistant to fatigue and have a slow contraction speed, while the force generated by them is small. Therefore, they are recruited during tasks related to simple functional movements and maintaining correct postural control[9]. An equally important function of the local stabilisers is proprioception, defined as a specialised sensory function including the ability to determine the position of the body in space and to experience the sensation of movement[26].

In the presented research, all patients underwent a 3-week physical therapy programme with elements of deep muscle training. The training took place 6 times a week, on average, for 3 hours a day. The transverse abdominal muscle is the innermost flat abdominal muscle. It forms a closed cylinder around the body, narrowing the lower part of the chest, producing the abdominal press and pulling the abdominal wall transversely[21]. Learning under the control of a monitor allowed for selective and correct activation of the transverse abdomen muscles. In both groups of patients, there were changes in the thickness of the TrA muscle in relation to the 1st exam, these differences concerned measurements during muscle relaxation and its activation. The greater thickness of the muscle during both relaxation and contraction in both exams was recorded in the group of older people, while the greater difference in muscle thickness between contraction and relaxation was obtained in the group of younger participants. In both groups, in the 2nd exam, there was a significant, strong and positive correlation between TrA muscle thickness at rest and the difference in muscle thickness.

According to Ota et al.[27], age-related muscle atrophy occurs in the superficial abdominal muscles at an early age, and age-related atrophy is not as severe in the deep abdominal muscles, such as the transverse abdominal muscles. A similar position is presented by Fukomoto et al.[28] who examined the age-dependent quantitative and qualitative changes in the muscles of the trunk and limbs of the studied women. In total, 128 women were divided into 4 age groups: young, middle-aged, young-old and old-old. Muscle thickness (MT) and intensity of muscle echo (EI) were examined via ultrasonography in B mode for the following muscles: biceps, quadriceps, rectus abdominis, external and internal oblique, and transverse abdominal. EI of the biceps brachii, quadriceps femoris and transversus abdominis were significantly higher in the middle-aged group than in the young group, however, there were no significant differences in the MT study. Compared to the group of young people, all other groups had significant changes in both MT and EI examination of the rectus abdominis, and the oblique external and internal muscles. The authors suggest that qualitative changes in muscles may occur earlier than quantitative ones, and muscle loss may occur earlier in the abdominal surface muscles than in deep ones[28].

A limitation of the presented project is the lack of sonofeedback inclusion in the therapeutic procedure. This would allow greater activation of the TrA muscle. In future studies, the authors also suggest the inclusion of superficial muscle testing in the protocol as a valuable complement to the image of involutional changes. Changes that occur in the motor system during the aging process affect its efficient functioning, such as the ability to move, and perform complex and basic activities of everyday life. The consequence of the aging process in this system are, among others, changes in body posture and gait pattern, as well as an increased risk of falls in this age group. Reduction in efficiency as a result of a reduction in muscle mass and strength, deterioration of psychomotor coordination, the balance organ and slowing the release of impulse conduction in the nervous system are the cause and result of reduced physical activity among older people. It is worth emphasising that the pace of the presented changes can be modified by lifestyle. For example, the average reduction in muscle mass between the age of 30 and 60 is about 5% per decade, while after the age of 60 even 10%. These changes are considerably higher in patients with a sedentary lifestyle and/or improper eating habits[29,30,31]. Demographic forecasts clearly indicate the progressive aging of society. In view of this demographic situation, it is necessary to focus social policy not only on extending life, but also on taking actions that improve its quality among seniors.

CONCLUSIONS

1. Quality of life among the subjects under study clearly improved after application of the physiotherapy programme with elements of deep muscle training.
2. The application of the physiotherapy programme with elements of deep muscle training influences changes in TrA muscle thickness.
3. The implementation of the original exercise programme combined with deep muscle training in those suffering from osteoarthritis of the large joints leads to favourable changes in TrA muscle thickness, primarily in those above the age of 60.

References

1. Bogus K., Borowiak E., Kostka T. Otyłość i niska aktywność ruchowa jako ważne czynniki determinujące jakość życia osób starszych. Geriatria 2008; 2: 116-120.
2. Karmakar N., Datta A., Nag K., Tripura K. Quality of life among geriatric population: A cross-sectional study in a rural area of Sepahijala District, Tripura. Indian J Public Health 2018; 62: 95-99.
3. Guyatt G., Ferrans C., Halyard M. Jakość życia zależna od stanu zdrowia – od badań klinicznych do praktyki lekarskiej. Kluczyńska A. (transl.). Med Dypl 2008; 4: 24-32.
4. Kelly A., Rush J., Shafonsky E., Hayashi A., Votova K., Hall C., et al. Detecting short-term change and variation in health-related quality of life: within- and between-person factor structure of the SF-36 health survey. Health Qual Life Outcomes 2015; 13: 199-201.
5. Iwańczyk K., Lemiesz G., Czaprowski D. Trening stabilizacji kompleksu lędźwiowo-miedniczno-biodrowego. Prakt Fizjoter Rehabil 2013; 9(42): 5-11.
6. Lord S.R. Visual risk factors for falls in older people. Age Ageing 2006; 35: 42-45.
7. Perrin P., Deviterne D., Hugel F., Perrot C. Judo better than dance, develops sensorimotor adaptabilities involved in balance control. Gait Posture 2002; 15: 187-194.
8. Comeford M., Mottram S. Kinetic Control. The Management of Uncontrolled Movement. Elsevier 2014: 91-94.
9. Hodges P.W., Eriksson A.E., Shirley D., Gandevia S.C. Intra-abdominal pressure increases stiffness of the lumbar spine. J Biomech 2005; 38: 1873-1880.
10. Kucab-Klich K., Suchińska A. Stabilizacja centralna w zespołach bólowych kręgosłupa lędźwiowego. Strategie terapii w ujęciu treningu mięśni dna miednicy. Prakt Fizjoter Rehabil 2015; 57: 46-53.
11. Marchewka A., Jungiewicz M. Aktywność fizyczna w młodości a jakość życia w starszym wieku. Gerontol Pol 2008; 2(16): 127-130.
12. Michalak K., Czechowska B., Wolny T., Motylewski S., Poziomska-Piątkowska E. Zastosowanie fizjoterapeutycznego obrazowania ultrasonograficznego i sonofeeddbacku w ocenie aktywności mięśnia poprzecznego brzucha. Fizjoter Pol 2017; 4(17): 50-61.
13. Zasadzka E., Wieczorowska-Tobis K. Zmiany w układzie ruchu w procesie starzenia się. Gerontol Pol 2014; 3:161-165.
14. Szewczyczak M., Stachowska M., Talarska D. Ocena jakości życia osób w wieku podeszłym- przegląd piśmiennictwa. Now Lek 2012; 81(1): 96-100.
15. Żołądź J.A., Majerczak J. Wpływ starzenia się na wydolność fizyczną człowieka. Fizjologiczne procesy starzenia 2011: 58-61.
16. Kowalik S., Ratajska A., Szmaus A.W poszukiwaniu nowego wymiaru jakości życia związanego ze stanem zdrowia. [In:] Wołowicka L. (ed.). Jakość życia w naukach medycznych. Poznań 2001: 19-29.
17. Kalfoss M., Halvorsrud L. Important Issues to Quality ofLife Among Norwegian Older Adults: an Exploratory Study. Nurs Open 2009; 3: 44-55.
18. Al-Windi A., Elmfeldt D., Tibblin G., Svärdsudd K. The influence of sociodemographic characteristics on well-being and symptoms in a Swedish community: results from a postal questionnaire survey. Scand J Prim Health Care 1999; 17: 201-209.
19. Kurowska K., Kajut A. Samoocena jakości życia osób starszych na przykładzie pensjonariuszy Domu Pomocy Społecznej (DPS). Psychogeriatr Pol 2011; 8(2): 55-62.
20. Sołowiński T. Stabilizacja centralna. Bikeboard 2011; 9: 20-23.
21. Brukner P., Khan K. Kliniczna Medycyna Sportowa 2012: 158-163.
22. Gnat R., Saulicz E., Kuszewski M. Współczesne poglądy na temat systemów stabilizacyjnych kompleksu biodrowo-miedniczno-lędźwiowego. Fizjoterapia 2006; 14(3): 68-82.
23. Janssen I. Evolution of sarcopenia research. Appl Physiol Nutr Metab 2010; 35: 707-712.
24. Tanaka H., Seals D.R. Endurance exercise performance in masters athletes: age associated changes and underlying physiological mechanisms. J Physiol 2008; 586: 55-63.
25. Roubenoff R., Hughes V.A. Sarcopenia: current concepts. J Gerontol A Biol Sci Med Sci 2000; 55: 716-724.
26. Zielonka-Pycka K., Szczygieł E., Golec J. Medycyna Sportowa / Polish J Sport Med. 2017; 4(4): 249-258.
27. Ota M., Ikezoe T., Kaneoka K., Ichihashi N. Age-related changes in the thickness of the deep and superficial abdominal muscles in women. Arch Gerontol Geriatr 2012; 55(2): 26-30.
28. Fukumoto Y., Ikezoe T., Yamada Y., Tsukagoshi R., Nakamura M., Takagi Y., et al. Age -Related Ultrasound Changes in Muscle Quantity and Quality in Women. Ultrasound Med Biol 2015; 41(11): 3013-3017.
29. Wieczorowska-Tobis K. Zmiany narządowe w procesie starzenia. Pol Arch Med Wewn 2008; 118 (Suppl): 63-68.
30. Morley J.E. Falls – where do we stand? Mo Med 2007; 104: 63-67.
31. Briggs A.M., Greig A.M., Wark J.D., Fazzalari N.L., Bennell K.L. A review of anatomical and mechanical factors affecting vertebral body integrity. Int J Med Sci 2004; 1:170-180.

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