

The effect of rehabilitation fitness on mature women with scoliosis

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Abstract

Purpose. The purpose of the study is to substantiate the content of rehabilitation fitness for mature women with scoliosis.

Material & Methods. The study involved 15 women aged 45-55 years with scoliosis of 1-2 degrees. Research methods: analysis, generalization and systematization of data from scientific and methodical literature, Internet networks; Testing method; Pedagogical research methods (pedagogical observation, pedagogical experiment); Clinical research methods (anthropometry, REEDCO posture scale, Kettle index, stooping index); Methods of mathematical statistics.

Results. A physical therapy program has been developed for mature women with scoliosis. After 6 months, statistically the average body weight decreased to 79.1 ± 1.9 kg and body mass index from 29.9 ± 1.0 kg to 29.5 ± 1.0 kg. We explain this result by the fact that the exercises were not dynamic and without great physical exertion, they were performed at a slow pace. After the pedagogical experiment, a slight but reliable decrease was established in heart rate - by 3.21 bpm (93.49 ± 2.2 at $p < 0.05$). The average values of blood pressure have only tendency to decrease as a result of the physical therapy program's impact on the female body (144.2 ± 4.5 mmHg was recorded on 94.6 ± 3.3 mmHg at $p > 0, 05$). The breath rate indicator reliably decreased by 2.5 beats/min (22.4 ± 0.9 beats/min), but still indicate a decrease in the functional capabilities of the respiratory system. There have been positive changes in the posture assessment of mature women - 57.7 ± 1.9 points out of 100 possible (the results are statistically significant). In general, the result is still low, but it is a positive trend in adults. The stooping index was $80.9 \pm 1.2\%$. There were slight but statistically significant changes. The level of physical condition of women has generally improved. Thus, the number of women with a low level of physical condition decreased to 20%; from below average to 33.3%; from the average to 33.3. It should be noted that the group included women with a higher than average level of physical condition - 13.3%. After the pedagogical experiment, indicators of well-being, activity and mood among women has improved. Thus, 60% of women had satisfactory and 40% - good well-being. Most of researched women (66.7%) have average activity and a good mood. So, the effectiveness of the developed program has been confirmed.

Conclusions. Recent studies indicate a deterioration in the health of the population of Ukraine. Treatment protocols for mature women with scoliosis in different countries of the world are similar. A 6-monthes physical therapy program has been developed and tested for mature women with scoliosis. The program includes the BALLance method by Dr. Tanja Kühne and the J. Pilates system (large equipment). After a pedagogical experiment, its effectiveness has been proven.

Key words: women, adult scoliosis, rehabilitation fitness, balls, reformer.



Introduction

According to the assessment of WHO experts, the quantitative indicators of diseases of the skeletal system occupy the fourth place after diseases of the cardiovascular system (CVS), oncological diseases and Covid (Internet resource of the State Statistics Service of Ukraine, 2024; Internet resource of the Ministry of Defense of Ukraine, 2024). Scoliosis occupies a leading place in the structure of orthopedic pathology. The problem of the development of spinal deformities and their treatment remains one of the most complex problems of our time. That is why it is increasingly attracting the attention of scientists, doctors and physical therapists (Andriychuk et al., 2021; Newton et al., 2018; Tamozhanska, et al., 2016; Delbrück et al., 2024; Rubin, et al., 2021). Studying the scientific and methodological literature, we found out that most of the studies devoted to the correction of musculoskeletal disorders concerned children and adolescents. The problem of scoliosis in adults is not sufficiently covered. It has been proven that women suffer from spinal curvature 10 times more often than men (Aebi, 2005). Unfortunately, during the war and against the backdrop of a decrease in physical activity, scoliotic disease increasingly affects various population groups.

Scoliosis is a disease that worsens the quality of life of an adult, disrupts their working capacity and provokes the development of concomitant diseases, contributing to the disability of the population (Aebi, 2005; Kelly et al., 2020; Duncan, 2017). The cause of adult scoliosis is not always known. Some cases are simply a progression of idiopathic scoliosis that was never diagnosed or corrected during adolescence. However, adult scoliosis can also be caused by various degenerative conditions, previous spinal surgeries, or pelvic obliquity (misalignment). Scoliosis in adults is often accompanied by significant osteochondrosis or intervertebral hernia and, unfortunately, progresses quite quickly in patients with osteoporosis (Being Diagnosed with Scoliosis as an Adult, 2022; Rubin et al., 2021; Kashuba et al., 2024) and often worsens in mature women during menopause (Anwar et al., 2010). Scoliosis in adults is idiopathic or degenerative, has a more pronounced form and is almost always accompanied by pain syndrome (Newton et al., 2018). This requires a special approach and comprehensive treatment. For the treatment of scoliosis, mechanotherapy is used, first of all, (training on rehabilitation simulators: the Exten Trac Elite complex, the TRACTIZER system, the Unitrend rehabilitation device); manual and underwater jet massage; electrical muscle stimulation; physical exercises (Evminov's method, SEAS exercises for scoliosis (Italy) (Romano et al., 2015), Dobo-

med's method (Poland) (Fabian et al., 2014), FITS method (Białek, 2015); soft manual techniques for restoring nutrition in the intervertebral discs; physiotherapy (Riabenko et al., 2023), etc.

In adult patients with spinal deformities, it is very difficult to predict the course of progression and treatment, since concomitant diseases (diabetes, hernias, etc.) are added. In adulthood, scoliosis cannot be cured, so it is necessary to eliminate the unpleasant manifestations accompanying it: pain, stiffness, restrictions in movement, etc.

Since scoliosis significantly worsens the quality of life, due to reduced working capacity and is a provoking factor for many diseases of internal organs, there is a need to find more advanced and effective methods and means. In our opinion, attention should be paid to rehabilitation fitness - the use of modern health and rehabilitation equipment, namely the use of certified equipment (ISO 9001 quality control standard) – balls of different sizes ($d=9$ cm; $d=11$ cm) of the «BALLance Dr. Tanja Kühne method» (Cornely, 2015; Kühne, 2015) and large equipment according to the Pilates system (Wood, 2018; Ricci, 2019).

The *purpose* of the study is to substantiate the content of rehabilitation fitness for mature women with scoliosis.

Material and methods of research

Participants

The study was conducted at the Pilates Lviv studio. The study involved 15 women aged 45-55 years with scoliosis of 1-2 degrees. The pedagogical experiment has been lasting for 6 months. During the 55-minute classes, which were held 2 times a week, attention was paid to methodological instructions on the correctness of performing physical exercises. The program included one class on balls, the second – on a reformer. The training was conducted by a qualified and certified trainer in Pilates and BALLance Dr. Tanja Kühne method.

The criteria for including women in the study were:

- diagnosis of scoliosis;
- age 44–60 years (mature age);
- absence of severe concomitant pathologies of the musculoskeletal system and cardiovascular system;
- duration of the disease ≥ 5 years;
- absence of contraindications to physical activity;
- availability of time for systematic attendance of classes;
- consent to participate in the study.

We did not form a second group – a comparison group, because other clients of the fitness

studio did not meet the inclusion criteria in the study. That is why our pedagogical experiment was consistent and all indicators were compared with the normative ones.

Methods

The analysis of scientific and methodological literature allowed us to study the current state of the problem comprehensively; clinical research methods (anthropometry, stoop index, posture assessment (REEDCO Posture Score Sheet scale, REEDCO Research, 1974), Kettle index, level of physical condition; survey method (questionnaire); testing method (SAN methodology "Well-being, activity, mood" for determining the psycho-emotional state of women); pedagogical research methods: pedagogical experiment, which was formative in purpose (it involved developing a physical rehabilitation program for mature women with scoliosis); natural in terms of conduct (it did not involve significant changes in the usual conditions of the rehabilitation process); open in nature (awareness) (the purpose and objectives of the study were brought to the attention of all participants in the experiment); by direction – sequential (comparison of control indicators before the introduction of the experimental factor into the process and after a certain time of its influence on the participants of the experiment of those who are engaged. It is used when the group of people who are engaged is very small and there is no possibility of creating a similar group for control) (Kostyukevich et al., 2016). Pedagogical observation made it possible to observe participants, who performed physical exercises according to the developed physical therapy program, systematically and purposefully. According to the typology, pedagogical observation was: problematic, by program – basic, by style – included, by awareness – open, by time – continuous; methods of mathematical statistics (\bar{X} , V). We checked all the results of the indicators for compliance with the normal distribution. Since the results did not correspond to a normal distribution (at $n=15$) according to the Shapiro-Wilkie t-test, nonparametric criteria (Wilcoxon test) was used to verify the assessment of a statistically significant difference in the study (Kostyukevich et al., 2016).

Statistical analysis

Mathematical and statistical processing and data analysis were carried out using the computational capabilities of the Statistica application packages (StatSoft, version 10.0) and Microsoft Excel 2010.

In the process of the study, we followed the rules of patient safety, preservation of their rights and canons of human dignity, as well as moral and ethical norms, in accordance with the basic provisions of the Convention on Human Rights and

Biomedicine, the Helsinki Declaration of Human Rights, the Ethical Principles of Medical Research with Human Participation, the Universal Declaration of Bioethics and Human Rights, the Law of Ukraine "On Scientific and Scientific and Technical Activity", etc.

The work was carried out in accordance with the scientific topics of the Department of therapy and rehabilitation "Improvement of approaches to physical therapy of persons who have or may have functional restrictions" and the Department of fitness and recreation "Healthy physical activity in recreational activities of various population groups of Ukraine" for 2021–2025 years in Lviv State University of Physical Culture named after Ivan Boberskyj.

Results

There are observed negative trends of a sharp deterioration in the health of the population of Ukraine due to the restriction of physical activity, bad habits and unhealthy diet, stress due to war and environmental pollution.

Diseases of the musculoskeletal system and connective tissue occupy the fourth place among the diseases of the adult population of Ukraine according to the Ukrainian State Research Institute of Medical and Social Problems of Disability of the Ministry of Health of Ukraine (Internet resource of the State Statistics Service of Ukraine, 2024; Internet resource of the Ministry of Defense of Ukraine, 2024). 2-3% of the population suffers from scoliosis according to the American Association of Neurological Surgeons (Being Diagnosed with Scoliosis as an Adult, 2022).

In adulthood, there is a decrease in body length – a regressive stage by shortening of the spine due to its curvature and flattening of the intervertebral discs. In adulthood, the incorrect position of the spine and muscle spasms, weakness increase back pain, which was actually confirmed by women of mature age in their answers to the questionnaire. In part, the spine tenses in the area of curvature, so movement becomes limited. All participants of the study (women of mature age) had scoliosis of the 1st degree according to the survey. The thoracic right-sided scoliosis was most often – 53.3%.

We conducted a rehabilitation examination and average indicators are presented in Table 1. It should be noted that the average indicators of heart rate and blood pressure, breath rate were overestimated in women who participated in the pedagogical experiment.

We have used the REEDCO posture scale, stoop index, and Kettle index to assess the condition of the musculoskeletal system of women (REEDCO Research, 1974). We have payed attention to the following main features to assess nor-

Table 1. Indicators of rehabilitation examination of women before the pedagogical experiment (n=15)

No.	Indicator	$\bar{X} \pm m$	σ	V (%)
1.	Weight, kg	80,2±2,0	7,88	9,8
2.	RR, cycle/min	24,9±0,9	3,56	14,3
3.	HR, beats/min	96,7±2,3	9,48	9,8
4.	BP _{syst} , mmHg	144,2±4,5	17,29	12,0
5.	BP _{diast} , mmHg	94,6±3,3	12,66	13,4
6.	BMI	29,9 ±1,0	3,90	13,0

mal posture: the location of the spinous processes of the vertebrae on one vertical line; the location of the upper arms and shoulders on the same level; the location of the angles of both shoulder blades on the same level; equal triangles of the waist formed by the lateral surface of the body and freely lowered arms; the location of the gluteal folds on the same level; correct curvatures of the spine in the sagittal plane etc. (Kashuba et al., 2020).

We examined the posture of women in the frontal and sagittal planes and calculated the stoop indices for all participants to assess. It should be noted that the average statistical results of posture assessment of the studied women were corresponded to 55.0±1.7 points out of 100 possible. In our opinion, it is a low score. The points of REEDCO posture scale ranged between 45-65.

Stoop in an adult is a back deformation, which is most often as consequence of muscle weakness and long-term incorrect posture. Regarding stoop, it was found that the vast majority (60%) of women have a tendency to stoop, 33.3% are stooped and only 6.7% have the norm according to the corresponding index. That is why the average result of the stoop index in mature women was 79.9±1.2%, which is the upper limit of the stoop index (N<80%).

We also found that the average body mass in women reached 80.2±2.0 kg. The body mass index is more informative, where the average indicator (29.9±1.0) means excess body weight. It should be noted that 3 women were diagnosed with obesity of the 1st degree and 3 women with obesity of the 2nd degree, the norm indicator was not detected.

The indicator of the physical condition of women is quite important. According to the results of the study, at the beginning of the pedagogical experiment, 33.3% of people had low level of physical condition, 40.0% of women had level of physical condition below average and in 26.7% the level was assessed as average.

As we know, scoliosis usually causes pain in various parts of the spine and a depressive state, that is why there was a necessity to assess the mental health of the participants in the experiment. So, we chose a methodology whose indicators reflect a qualitative characteristic of their psycho-emotional state: well-being, activity, mood (Table 2).

Table 2. Indicators of the psycho-emotional state of mature women (%)

	Value	Experimental group
well-being	Unsatisfactory	20,0
	Satisfactory	60,0
	Good	20,0
activity	Low	66,7
	Average	33,3
	High	-
mood	Poor	33,3
	Satisfactory	33,3
	Good	33,3

We recorded problems in the ascertaining experiment and selected physical therapy tools to solve them (Table 3).

Table 3. Selection of physical therapy tools according to existing problem

Problems that have been identified in women	Physical therapy tools
Dyspnea	static and dynamic breathing exercises with an emphasis on prolonged exhalation from different starting positions (s.p.) (different ball positions, exercises on the reformer: «bridging ref» «foot work»)
Pains in the chest and lumbar regions	stretching exercises
Increased RR, BP	static and dynamic breathing exercises (different s.p. and different ball positions; exercises on the reformer «back hand sitting», «knee stretches», «short back»)
General weakness, rapid fatigue	physical exercises from a sitting and lying position
Violation of the psycho-emotional state	physical exercises lying on the back («massage» - rolling/moving the balls up and down; exercise «mermaid»)

The physical therapy program was developed for these women who had I grade scoliosis taking into account the identified problems. The program provided the principles of physical therapy and physical education.

The structure of the classes consisted of three generally accepted parts: preparatory, main and final. Thus, in the preparatory part, exercises were offered for stretching and activation of attention and awareness. In the main part, exercises were performed according to the BALLance Dr. Tanja Kühne method or a set of physical exercises on a reformer to influence on deep and superficial muscles, restore symmetry of the muscles that form posture, improve their tone, strength and flexibility. Due to this, the physiological curves of the spine were normalized, the position of the shoulder and pelvic girdles was symmetrical.

Thus, the set of physical exercises according to the BALLance Dr. Tanja Kühne method involved performing exercises with controlled breathing in different starting positions (lying on the back, on the side) and with different arrangements of the balls. Women had to master the basic exercise, the starting position of which ensured: a decompressive state of the spine; minimal influence of gravity (Fig. 1). The basic exercise and the position of "hands behind the head" ensured: lifting the chest (clavicles, shoulder blades); stretching the pectoralis major, pectoralis minor and serratus anterior muscles.

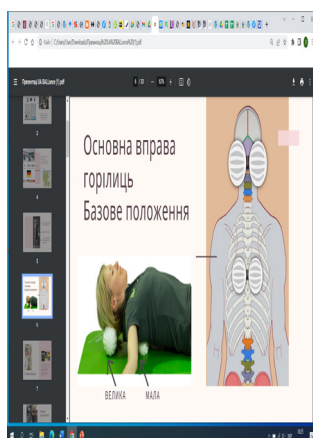


Figure 1. View of the basic exercise with the correct placement of the balls.

When performing the chest extension exercise, the ribs rise during inhalation, the chest expands. When flexing during exhalation, the

chest approaches the pelvic girdle. The functional muscle groups that provide this movement are included in the work. The external oblique muscle of the abdomen, the internal oblique muscle of the abdomen, the transverse muscle of the abdomen, the pyramidal muscle, the rectus abdominis muscle are contracted, also as the neck muscles and scalene muscles are contracted.

During the exercise, the intervertebral discs are in a state of decompression. The functional muscle groups of deep inhalation are involved, the chest expands in the sagittal and frontal planes. The costovertebral joints, costotransverse joints, sternocostal joints, and the ligamentous apparatus are involved. With repeated repetition of the exercise, the morphological parameters of the chest change.

It was also important to perform the exercises on the side with the correct location of the balls (Fig. 2).

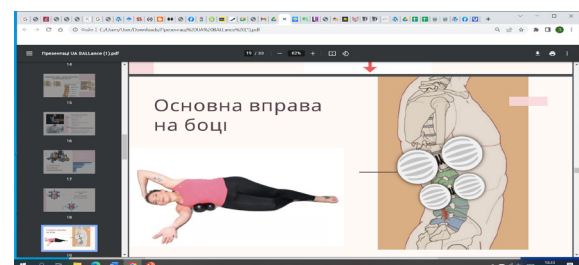


Figure 2. Basic exercise on the side.

The exercise additionally involves the muscles of the lumbar and cervical spine, which provide a tilt of the torso in the direction opposite to the force of gravity. In the side position, with your hand behind your head, conditions are created for stretching the muscles, which provide a deep breath.

So, when performing basic exercises with BALLance balls, all the muscles of the musculo-skeletal system work (the muscular system is a single whole, when one muscle contracts, this is reflected in the state of all other muscles) as part of certain functional muscle groups (FMG) according to the principle of a muscle chain.

FMG provide: lumbar flexion; lumbar extension; lumbar inclinations; neck flexion; neck extension; neck inclination; calm inhalation; calm exhalation; deep inhalation; deep exhalation; straining. When performing exercises with BALLance balls, the FMG constantly work in all basic exercises, the morpho-functional parameters of the chest change: transverse, longitudinal and sagittal dimensions.

The physical therapy program for mature women also included a set of physical exercises on the reformer (Fig. 3).

For example, the physical exercise "Foot work" promotes mobility of the hip joints, improves the

Reformer Exercise Preview

An excerpt from the Reformer Easy Start Poster Guide



Figure 3. A set of physical exercises on the reformer.

Table 4. Changes in indicators before and after the pedagogical experiment (n=15)

No.	Indicator	before the pedagogical experiment			after the pedagogical experiment			t-criteria Wilcoxon, P
		\bar{X}	σ	V (%)	\bar{X}	σ	V (%)	
1.	Weight, kg	80,2±2,0	7,88	9,8%	79,1±1,9	7,52	9,5%+	p<0,05
2.	RR, cycle/min	24,9±0,9	3,56	14,3	22,4±0,9	3,56	15,9	p<0,05
3.	HR, beats/min	96,7±2,3	9,48	9,8	93,49±2,2	8,48	9,0	p<0,05
4.	BP _{syst} , mmHg	144,2±4,5	17,29	12,0	141,9±4,6	17,67	12,5	p>0,05
5.	BP _{diast} , mmHg	94,6±3,3	12,66	13,4	91,8±2,9	11,15	12,1	p>0,05
6.	BMI	29,9 ±1,0	3,90	13,0	29,5 ±1,0	3,72	12,6	p<0,05

elasticity of the posterior surface of the thigh, flexors and adductor muscles of the thigh; the physical exercise "Bridging Ref" improves mobility of the spine, promotes lengthening of the extensor muscles of the back; the physical exercise "Standing Hip Stretch Ref" improves maintaining the spine in a neutral position, improves coordination and mobility of the hip joints. Women also performed exercises "knee stretches", "short back", "mermaid", etc.

While performing the exercises, the women were instructed that the exercises should not cause pain, should not be overexerted, and should promote overall recovery. After the session, there should be a pleasant, light fatigue.

Indicators were taken before and after class each time. However, mathematical processing was done after the pedagogical experiment. There was provided the possibility of individual adjustment of the intensity of the load during the classes.

In the final part, women performed relaxation and coordination exercises. Our choice of physical exercises was based on their anatomical justification.

There was detected no deterioration of any of

the studied indicators during the 6 months - the period of the pedagogical experiment and at the time of its completion. Let us consider the changes in the indicators that were studied (Table 4).

We found that the average body weight of women statistically decreased from 80.2±2.0 kg to 79.1±1.9 kg during the experiment period. As for the body mass index, there were minor but significant changes in the indicator: from 29.9±1.0 kg to 29.5±1.0 kg. Let us note the information in absolute figures: one woman's BMI corresponds to the norm, the number of women in the groups of participants of the experiment with obesity of the I and II degrees decreased by one. We explain this result by the fact that the physical exercises were not dynamic and without great physical exertion, they were performed at a slow pace. In general, the physical therapy program had a different goal.

Thus, the average heart rate was 96.7±2.3 beats/min, and after the pedagogical experiment, minor but significant positive changes were found: heart rate decreased by 3.21 beats/min (93.49±2.2). The average BP_{systolic} was recorded at 144.2±4.5 mmHg, BP_{diastolic} was 94.6±3.3 mmHg, but p>0.05. This indicates only a ten-

dency to decrease as a result of the influence of the physical therapy program on the female body (see Table 4).

Measurement of the RR showed that the average indicator was 24.9 ± 0.9 , which is above the norm and indicates a decrease in functional capabilities of the respiratory system. In an adult in a state of physiological rest, the norm is 16–20 respiratory movements per minute. The respiratory rate after the pedagogical experiment significantly decreased by 2.5 beats/min and was 22.4 ± 0.9 beats/min (see Table 4).

We re-examined the posture of women in the frontal and sagittal planes. The results of the formative experiment prove a positive trend in improving the average statistical results in assessing the posture of mature women 57.7 ± 1.9 points out of 100 possible (the results are statistically significant). The average result after the pedagogical experiment is still low, the scores on the REEDCO posture scale ranged from 50-70 (see Table 4).

Posture assessment with stoop index is more complex. The stoop index was re-calculated in order to assess changes in posture after the pedagogical experiment. Thus, the average stoop index is $80.9 \pm 1.2\%$. It should be noted that after the pedagogical experiment, 3 women had a normal stoop index, and the quantitative composition in the groups with the indicators of "stooping" and "tendency to stoop" decreased by one woman. There were minor, but statistically significant changes. This is explained by the fact that in adulthood it is quite difficult to correct posture. The percentage distribution of women between the norm, a tendency to stoop and stoop is shown in Fig.4. Therefore, the number of women with a norm of the stoop index increased to 20%, with a tendency to stoop – decreased to 53.3%, with stoop – to 26.7%.

So, after the pedagogical experiment the level of physical condition of women in general improved according to the results of the study. Thus, the number of women with a low level of physical

condition decreased to 20%; with a lower than average level – to 33.3%; with an average level – to 33.3%. It should be noted that women with a higher than average level appeared in the group – 13.3% (Fig. 5).

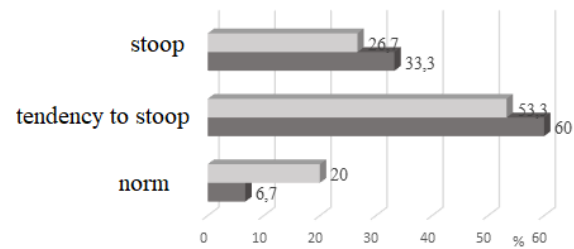


Figure 4. Distribution of mature women with scoliosis according to the results of the stoop index ($p \leq 0.05$)

It should be noted that all women experienced an improvement in their functional and psychoemotional state. We also conducted a repeated survey to determine the impact of the physical therapy program on the well-being, activity and mood of women (SAN method) (Table 5).

Table 5. Changes in indicators of the psychoemotional state of mature women under the influence of classes (%)

Value	Experimental group		
	before	after	
well-being	Unsatisfactory	20,0	-
	Satisfactory	60,0	60
	Good	20,0	40
activity	Low	66,7	33,3
	Average	33,3	66,7
	High	-	-
mood	Poor	33,3	-
	Satisfactory	33,3	33,3
	Good	33,3	66,7

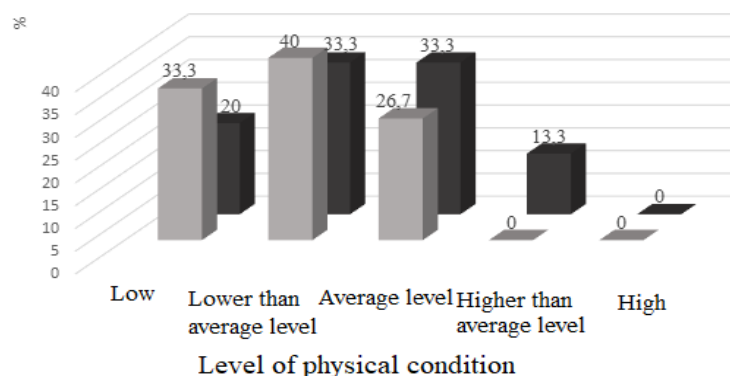


Figure 5. Indicator of the level of physical condition of women before and after the pedagogical experiment

After the pedagogical experiment, the indicators of well-being, activity and mood in women improved. Thus, 60% of women had satisfactory and 40% – good well-being. Most of them (66.7%) have average activity and good mood.

Discussion

The problem of the development of spinal deformities and their treatment remains one of the most difficult problems in orthopedics and vertebrology. Adult scoliosis is defined as a spinal deformity in a skeletally mature patient with a Cobb angle of more than 10 degrees in the coronal plain. Adult degenerative scoliosis begins in adulthood. It occurs when the discs begin to degenerate, arthritis affects the facet joints and the disc spaces collapse. After 40 years of age the incidence of scoliosis increases and, the majority of scoliosis cases in adults occur in people over the age of 60. Scoliosis in adults can be corrected but it cannot be cured entirely. Adult patients with scoliosis are characterized by: pain and discomfort in the back and lower extremities; there are formed compensatory functions etc. We conducted a PubMed search using keywords "adult scoliosis" and "adult spinal deformity". The selection of articles included was subjective based on the discretion of the researchers but included what the authors considered landmark systematic reviews in the field of adult scoliosis. Conservative measures commonly employed by primary care physicians who by and large incidentally discover the scoliosis on routine radiological investigations performed for other reasons include out-patient medication and lumbo-sacral and thoraco-lumbo-sacral braces. These are not only poorly tolerated in the elderly but with regards bracing ineffective in the context of the transverse instability that dictates curve progression in scoliosis.

Non-surgical scoliosis treatments are supported by such scientists as van Dam (1988), Wood et al. (2018), Davybida et al. (2019), Dean Chou (2024).

So, Dean Chou pioneered minimally invasive techniques to treat adults with scoliosis. Many patients don't have symptoms and don't even know they have scoliosis. He claims that even patients with very large curvatures do not need treatment if they have no symptoms. They live normal lives, they're active, they go to work, and they do everyday things with scoliosis.

S. Frank conducted a study on the treatment of idiopathic scoliosis by manual therapy in combination with shock wave therapy (Frank et al., 2020). This is effective for patients with mild and moderate idiopathic scoliosis, as it allows you to relieve pain, restore blood circulation, etc. It should be noted that it is contraindicated in tumors and internal inflammatory processes, which

often occur in adulthood.

A number of foreign specialists consider surgical intervention effective. Thus, Myung-Sup Ko (2024) states that the objectives of fusion surgery for spinal deformities include decompressing neural elements and achieving balanced spinal alignment. Particularly, in cases where spinal deformities coexist with osteoporosis, successful surgery requires careful consideration due to the susceptibility to fixation failure and non-union. Various efforts are being made to restore spinal alignment through surgery in osteoporotic patients. It's only when the patient's pain is so bad, and their quality of life is so impeded, that surgery is indicated. Patients generally opt for surgery when their quality of life is unacceptable to them.

Zeng et al. (2012) provide results on surgical strategies for lumbar scoliosis in adults. Revision surgery may be necessary after decompression alone or decompression and fusion (Munish C. Gupta, 2003). Charles & Ntilikina (2020) believe that surgical treatment can provide a significant improvement in three-dimensional (3D) thoracolumbar alignment, function, and health-related quality of life. Mohammed Z. (2024) believes that limited interventions can provide symptomatic relief to adult spine deformity patients, with indications mostly in patients with balanced deformities and neurological pain. In our opinion, the treatment of scoliosis in adults should be comprehensive: special physical exercises (symmetrical and asymmetric; for coordination; for balancing; breathing; with objects, etc.), rehabilitation fitness; physiotherapy procedures; manual therapy; therapeutic massage; use of vitamins; nutritional supplements; in case of back pain – painkillers, antispasmodics, etc.

The key to successfully treating scoliosis without resorting to surgery is to diagnose and address the condition as early as possible by working with a scoliosis specialist to create a personalized treatment plan.

In our opinion, further research on the development and implementation of other effective rehabilitation and correction programs, taking into account the individual characteristics of the patient with scoliosis, makes sense.

Conclusions

1. Recent studies indicate a deterioration in the health of the population of Ukraine. Diseases of the musculoskeletal system and connective tissue occupy the fourth place in the structure of morbidity of the adult population of Ukraine.

2. Treatment protocols for mature women with scoliosis in different countries of the world are similar. To support and improve the functional capabilities of women with scoliosis, there is a need to develop a physical therapy program using

new methods, tools, equipment, etc. A modern means of influence is rehabilitation fitness. This may include the BALLance method by Dr. Tanja Kühne and the J. Pilates system (large equipment).

3. A 6-monthes physical therapy program has been developed and tested for mature women with scoliosis. It was found that the average body weight statistically decreased to 79.1 ± 1.9 kg. Confirmation of the positive dynamics is a minor statistically significant decrease in body mass index: from 29.9 ± 1.0 kg to 29.5 ± 1.0 kg. We explain this result by the fact that the physical exercises were not dynamic and without great physical exertion, they were performed at a slow pace. The average heart rate at rest was 96.7 ± 2.3 beats/min, and after the pedagogical experiment, a minor but significant decrease of 3.21 beats/min was established (93.49 ± 2.2 at $p < 0.05$). The average blood pressure also tended to decrease as a result of the impact of the physical therapy program on the female body (144.2 ± 4.5 mmHg was recorded at 94.6 ± 3.3 mmHg at $p > 0.05$). Measurement of the RR showed that after the pedagogical experiment there was a significant decrease by 2.5 cycles/min and was on average 22.4 ± 0.9 cycles/min, which further indicates a decrease in the functional capabilities of the respiratory system. The results of the formative experiment prove positive changes in the posture assessment index of mature women – 57.7 ± 1.9 points out of 100 possible (the results are statistically significant). In general, the result is still low and the scores on the REEDCO posture scale already fluctuated within 50-70, however, in adulthood this is a positive trend. The stoop index calculated after the pedagogical experiment was $80.9 \pm 1.2\%$: normally it had 3 women, one woman decreased in the indicators of "stoop" and "tendency to stoop". There were insignificant, but statistically significant changes.

4. The level of physical condition of women in general improved. Thus, the number of women with a low level of physical condition decreased to 20%; with a lower than average level – by 33.3%; with an average level – to 33.3. It should be noted that women with a higher than average level of physical condition appeared in the group – 13.3%.

5. After the pedagogical experiment, the indicators of well-being, activity and mood in women improved. Thus, 60% of women had satisfactory and 40% – good well-being. Most of them (66.7%) had average activity and a good mood.

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Supplementary Information

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