Effect of physiotherapy on body balance and quality of life in women suffering from multiple sclerosis – preliminary results

Wpływ fizjoterapii na zdolności zachowania równowagi oraz jakość życia kobiet chorych na stwardnienie rozsiane – wstępne wyniki

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Wstęp. Utrzymanie zdolności równowagi zależy od ciągłego przepływu informacji z układu wzrokowego, przedsionkowego, proprioreceptywnego, oraz z ośrodków motorycznych do zakończeń nerwów znajdujących się w mięśniach. Informacje te są przekazywane przez połączenia nerwowe z otoczką mielinową, która w SM (stwardnienie rozsiane) ulega demielinizacji.

Cel badań. Ocena wpływu postępowania fizjoterapeutycznego na zdolność zachowania równowagi oraz ocena jakości życia wśród kobiet chorych na SM.

Materiał i metoda. Badaniu poddano 30 kobiet chorych na SM. Do badania użyto następujących narzędzi pomiarowych: rozszerzona skala niewydolności ruchowej Kurtzkego (EDSS), skala równowagi Berg, platforma stabilometryczna oraz Index Jakości Życia Ferrans i Powers dla Stwardnienia Rozsianego.

Wyniki. Wyniki w ocenie skali Berg i na platformie stabilometrycznej wykazały zaburzenia równowagi wśród kobiet chorych na SM. Przeprowadzone usprawnianie fizjoterapeutyczne oraz trening na platformie stabilometrycznej miały wpływ na poprawę zdolności zachowania równowagi. Kobiety, które charakteryzowały się niższym wskaźnikiem jakości życia, miały większe trudności z zachowaniem równowagi.

Wnioski. Kobiety chore na SM mają zaburzoną zdolność do zachowania równowagi. Odpowiednio przeprowadzony proces rehabilitacji wpływa na poprawę równowagi. Stopień jakości życia ma wpływ na zdolność zachowania równowagi wśród chorych na SM. Kluczowym elementem procesu rehabilitacji pacjentów z SM jest dokładna ocena stanu pacjenta oraz jego zaburzeń funkcjonalnych. Rehabilitacja powinna być ukierunkowana na poprawę równowagi i koordynacji.

Słowa kluczowe: *stwardnienie rozsiane, równowaga ciała, rehabilitacja, jakość życia, kobiety*

Introduction. Maintaining body balance capacity depends on the continuous flow of information from the visual, vestibular, proprioceptive and motor centers of the nerve endings in the muscles. This information is provided by the myelinated nerves, which in MS (multiple sclerosis) are demyelinated.

Aim. To assess the impact of physiotherapy on the ability of keeping body balance and the quality of life among women with multiple sclerosis.

Material & Methods. To investigate the problem the authors used measurement tools such as the Kurtzke Expanded Disability Status Scale (EDSS), the Berg balance scale, stabilometric platform and Quality of Life Index Ferrans and Powers for Multiple Sclerosis.

Results. The results, expressed in the Berg balance scale and the stabilometric platform, showed imbalances among women with MS. The conducted physiotherapeutic streamlining and training on the stabilometric platform affected the improvement of the ability to keep balance. Women having a lower quality of life index had greater difficulties in keeping balance.

Conclusion. Women with MS have impaired ability to maintain body balance. Rehabilitation process performed accordingly improves balance. The degree of quality of life has an impact on the ability to maintain balance in patients with MS. An accurate evaluation of the MS patients' condition and functional disorders is the key element of the process of rehabilitation. The rehabilitation should be aimed at improving balance and coordination.

Key words: *multiple sclerosis, body balance, rehabilitation, quality of life, women*

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Introduction

The ability of maintaining the erected body posture depends on correct co-operation of such organs as auricle system, proprioreceptors and sight, taking part in maintaining balance. Stability of posture is also influenced by such physical traits as body mass, height, size and gauge of feet, as well as speed of nervous system in detecting the stability disruptions. All stages of the nervous system take part in the analysis of stimuli received from the outside. The nervous system participates in maintaining balance in a standing posture, influencing the motor organs through feedback loops. There is no constant balance during the vertical posture, but stability means a constant regaining of the lost balance. In standing one can observe a certain range of deviations from perpendicular (swaying). Its extend indicates the efficiency of balance control system. The range of deviations may be influenced by co-existing diseases, taken drugs, weakening of muscle strength, pain, fear, depression or fatigue, as well as by environmental factors: the kind of surface (hard or soft, movement in the surroundings, sight, auditory or sensory stimuli) [1, 2]. The body balance consists of two parts: static and dynamic. The static balance occurs when the patient`s body has an unchanging point of support – it can be influenced by genetic and environmental factors (as the degree of fitness). The dynamic balance is mostly environmentally influenced and depends on whether the organism can maintain the balance, having a changeable point of support [3].

Nerve fibers in our brain are covered with myelin theca, which is damaged in the course of Multiple Sclerosis. Maintaining balance depends on a constant flow of information from the sight, auricle and proprioreceptive system and from motor centers to nerve endings located in muscles. This information is conveyed by nerve connections covered by myelin theca, which can get demyelinated because of Multiple Sclerosis. That illness mostly appears between the 20th and 40th year of age and affects manly women. Its symptoms can be diversified, starting from the disturbances of sight, movement, balance and physical coordination, through tingling and numbness in limbs, weakening of muscle strength, to the loss of sphincter control. For the patients the most oppressive problems are ataxia and balance disorders, because they cause motor disabilities. Patients often notice that they take broader steps and have balance problems when beginning to walk or changing the direction. In the rehabilitation necessary are the balance and coordination exercises, strengthening of muscles, learning of correct walking patterns and utilization of compensation supplies of the organism. Nevertheless, the ataxia and balance disorders are the most therapy-resistant problems, often causing disability [4].

The Multiple Sclerosis is hardy recognizable in its initial stages. In fact, a reliable diagnosis can be made after two first phases of the disease or after detecting new changes in a MRI image during a period not shorter than 30 days. For clinical and scientific purposes used are the McDonald`s Criteria, elaborated for the first time in 2001. They are based on clinical data and on the results of some additional tests, such as the Magnetic Resonance (MRI) of brain and spinal cord, developed potentials and examinations of the cerebrospinal fluid. The revised McDonald`s Criteria, introduced in 2005, include some additional tests of MRI of brain and spinal cord, cerebrospinal fluid examinations and developed sight, brainstem and somatosensory potentials [5, 6]. The initial syndromes are often mild enough for the patient, who neither feels worried nor feels the need of consulting the doctor. This first Clinically Isolated Syndrome (CIS) does not always cause the further progress of the disease, but it usually comes back after some time with higher intensity and its course is hard to foresee. In certain patients symptoms subside for many years, whereas in others the disease progresses rapidly and causes disability in a short time. Therefore an early diagnosis is very important, because it enables qualification to an immunomodulating treatment which is the most successful in initial phases of the disease [7].

The quality of life is determined according to a degree of satisfaction with one's life, obtained in a long period. Everybody is capable of assessing their life on the basis of selected criteria and measurements [8]. The quality of life may be defined in many ways. Dalkey and Rutke described it as a "feeling satisfaction and good luck or its deficit". By Gill and Feinstein, the quality of life is "the way in which a man senses his health and other non-medical aspects of his life". According to de Walden-Gałuszko, the quality of life can be defined as "an image of one's situation in a certain length of time". With reference to health, assessed can be a change in quality of life caused by an illness and its treatment [9]. There are many scales to assess the quality of life of people with MS. Also a lot of questionnaires to measure other aspects of the disease and its consequences. However, the selection of tools for testing should be guided first and foremost by the objective of the study and psychometric properties [10].

Illnesses of the nervous system can be very diversified. Their symptoms often affect different parts of the body, which additionally hinders proper diagnosis. In such cases especially important is proper medical care and rehabilitation.

Aim

The aim of this paper is an estimation of influence of physiotherapeutic treatment on the balance maintaining ability, as well as an assessment of life quality in women suffering from Multiple Sclerosis. The research was conducted using the Kurtzke Expanded Disability Status Scale (EDSS), the balance scale by Berg, the stabilometric platform – Stability 2.0, and the Life Quality Index for Multiple Sclerosis by Ferrans and Powers.

Research questions:

1. Is the ability to maintain body balance disturbed in women suffering from MS, as compared to the testing group?
2. Does the physiotherapeutic treatment influence the body balance improvement in women suffering from MS? The stabilometric platform Stability 2.0 was used and the statistical significance of that interdependence was assessed.
3. Are the results of the balance test by Berg confirmed by using the stabilometric platform?
4. Does the degree of life quality assessment influence the body balance maintaining ability, evaluated with the Life Quality Index by Ferrans and Powers for MS? Also the statistical significance of that interdependence was tested.

Materials and methods

Tested were 30 women, residents of Zamość and surroundings, suffering from Multiple Sclerosis, which was confirmed through the MRI examination. The criteria qualifying for the test were as follows – ability for maintaining an upright posture, female gender and problems with maintaining balance, examination on the stabilometric platform Stability 2.0 and application of the Berg balance scale. Clinical stability for the last four weeks. The age of the patients varied from 30 to 57 years of age, with the average value of 46.47 years. Their illness lasted from 8 to 25 years, whereas the average length of that period amounted to 14.93 years. The women took part in a physiotherapeutic program on an outpatient basis for 3 weeks without Saturdays and Sundays. The research was conducted in the Zamość Rehabilitation Center. The results were statistically analyzed, using the Statistica 10 program.

In the first day examined was their clinical state, applying the Kurtzke Expanded Disability Status Scale (EDSS), their balance maintaining ability (using the stabilometric platform and Berg balance scale) and their quality of life (using the Life Quality Index by Ferrans and Powers for Multiple Sclerosis).

For three weeks, without Saturdays and Sundays, the women underwent the physiotherapeutic rehabilitation program, aimed for the improvement of their balance and coordination. For that purpose an everyday, 10-minute-long training on the stabilometric platform (biofeedback) was applied, as well as individual exercises in order to regain the balance of muscle tension, to learn correct motor patterns and post-isometric muscle relaxation, total exercise time lasted 45 minutes. Applied were also: magnetic field, cryotherapy, interference currents with a vacuum massage and ultrasounds therapy. They were a preparatory stage for the proper physiotherapeutical rehabilitation. Their aim was, above all, reducing the muscle tension, releasing and reducing pain. The balance ability in women was measured on the stabilometric platform Stability 2.0 and with the Berg balance test, in the first and last day of rehabilitation program. Every woman was submitted to two 30-second-long measurements on the platform, one with their eyes opened, the other one with eyes closed. The results were compared to the testing group of 30 women of age varying from 30 to 60 years, with the average value of 44.23 years. The study included women who were excluded due to dysfunctions of hip and knee, but at the time of the study did not report pain from the hip and lower spine. Neurological diseases were also excluded.

Results

The Kurtzke Expanded Disability Status Scale (EDSS)

The estimation of the patient`s state of health, made on the basis of EDSS, proved that an average obtained result amounted to 3.65 (at a 10-point scale, where 0=norm and 10=death). The lowest result reached 1.5 (full fitness with slight neurological symptoms), whereas the highest one was 5.5 (severe motor disability, locomotion possibilities up to 100 meters). The more detailed results are presented in Table I.

The Berg Balance Scale

Test results of the Berg balance scale indicate some balance problems, influencing the limitations in the patient's self-reliance. The average test result reached 33.57 points, whereas the maximum value amounted to 56. The lowest level reached 21, whereas the highest one 47. Among the tested women more than 76.67% obtained point scores in the range between 21-40 points, which confirmed their need of assistance in performing everyday chores. Such results indicated also a high probability of the patient`s falling. Only 23.33% of the patients were able to maintain a full self-reliance (Tab. II). After the rehabilitation period the results obtained using the Berg scale did not change in a statistically significant degree.

The Ferrans and Powers Life Quality Index for MS

In the Part I of the Index the tested women answered the questions about their satisfaction (or lack of satisfaction) with different aspects of their lives. The detailed results are presented on the table below (Tab. III). In the Part II the women characterized the spheres of their lives more or less important for them (Tab. IV). The results obtained during the stabilometric platform test for women convinced about their lower life quality were more diversified, but that interdependence was not statistically significant ($p>0.05$).

Table I. Assessment of the patient`s state according to Kurtzke Expanded Disability Status Scale (EDSS)
Tabela I. Ocena stanu pacjenta na podstawie rozszerzonej Skali Kurtzkego

EDSS result/ Wynik EDSS	Interpretation of the result /Interpretacja wyniku	n	%
1.5	full efficiency, minimum neurological symptoms /pełna wydolność przy obecnych minimalnych objawach neurologicznych	1	3.33
2	hardy noticeable motor disorder /dyskretna niewydolność ruchowa	2	6.67
2.5	slight motor disorder /nieznaczna niewydolność ruchowa	5	16.67
3	average motor disorder /niewydolność średniego stopnia	2	6.67
3.5	moderate motor disorder /umiarkowana niewydolność ruchowa	5	16.67
4	relatively high motor disorder /względnie duża niewydolność	8	26.67
4.5	moderately high motor disorder / średnio ciężka niewydolność ruchowa	1	3.33
5	quite a high disorder, self-reliant locomotion to 200 m /dość duża niewydolność, samodzielna lokomocja do 200 m	3	10.00
5.5	hard motor disorder, locomotion to 100 m /ciężka niewydolność ruchowa, lokomocja do 100 m	3	10.00

n – number of persons /liczba osób

Table. II. Balance test in Berg scale
Tabela II. Badanie równowagi w Skali Berg

The Berg test result /Wynik skali równowagi Berga	The interpretation /Interpretacja wyniku	n	%
0-20	a wheelchair-confined patient /pacjent uzależniony od wózka	0	0
21-40	aided-walking patient /pacjent chodzi z pomocą	23	76.67
41-56	independent patient /pacjent niezależny	7	23.33

Table III. The Ferrans and Powers Quality of Life Index for Multiple Sclerosis – Part I
Tabela III. Index Jakości Życia Ferrans i Powers dla Stwardnienia Rozsianego – część pierwsza

How much are you satisfied with...? /Jak bardzo jesteś zadowolona z...?	highly discontented /bardzo niezadowolony		moderately discontented /umiarkowanie niezadowolony		slightly discontented /nieznacznie niezadowolony		slightly satisfied /nieznacznie zadowolony		moderately satisfied /umiarkowanie zadowolony		very satisfied /bardzo zadowolony	
	n	%	n	%	n	%	n	%	n	%	n	%
health, medical care /zdrowie, opieka zdrowotna	0	0	0	0	13	43.33	2	6.67	15	50.00	0	0
family, friends /rodzina, przyjaciele	0	0	0	0	0	0	0	0	24	80.00	6	20.00
job, education /aspekty pracy, wykształcenie	0	0	9	30	17	56.67	4	13.33	0	0	0	0
emotional state /stan emocjonalny	0	0	0	0	6	20.00	11	36.67	13	43.33	0	0
your own image /własny wizerunek	6	20.00	7	23.33	9	30.00	6	20.00	2	6.67	0	0

Table IV. The Ferrans and Powers Quality of Life Index for Multiple Sclerosis – Part II
Tabela IV. Index Jakości Życia Ferrans i Powers dla Stwardnienia Rozsianego – część druga

How important for you is/are...? /Jak ważne dla Ciebie jest...?	completely unimportant /całkiem nieważne		moderately unimportant /umiarkowanie nieważne		slightly unimportant /nieznacznie nieważne		of a little importance /nieznacznie ważne		moderately important /umiarkowanie ważne		very important /bardzo ważne	
	n	%	n	%	n	%	n	%	n	%	n	%
health, medical care /zdrowie, opieka zdrowotna	0	0	0	0	0	0	0	0	0	0	30	100.00
dwelling conditions, architectural barriers /warunki mieszkaniowe, bariery architektoniczne	0	0	0	0	0	0	0	0	0	0	30	100.00
family suport, friends, emotional state /wsparcie rodziny, przyjaciele, stan emocjonalny	0	0	0	0	0	0	0	0	0	0	30	100.00
other people's opinions, neighbors /opinia innych osób, sąsiedzi	0	0	0	0	0	0	18	60.00	12	40.00	0	0

The Stabilometric Platform Stability 2.0

After comparing the first day results with the results of the testing group a distinct difference was noticed between the degrees of correction of forwards-backwards inclination with eyes opened and closed. This difference was statistically significant ($p<0.05$). All tested women moved their gravity centers backwards. In the table below presented are the average results for both groups. The values of inclination of gravity centers are given in millimeters (Tab. V).

Compared were also inclinations of gravity center between the first and last day of rehabilitation programs. Noticed were differences between values of corrections. In the first day the average inclination, measured in women with eyes closed, reached 18.23 mm, whereas with eyes opened – 16.15 mm. In the last day the inclination with eyes closed resulted 17.56 mm, whereas with eyes opened – 9.53 mm. All tested women moved their gravity centers backwards, but the difference proved statistically insignificant ($p>0.05$). The detailed results are put together in the table below (tab. VI). Compared were also the lengths of forwards-backwards inclinations of gravity centers from the first day (closed eyes test) between the group with the results from 21 to 40 (patients walking aided) and the group with results from 41 to 56 (independent ones). The women with their results varying from 21 to 40 in the Berg scale revealed an average value of inclination of about 19.23mm, whereas in the group with results from 41 to 56 the respective average value amounted to 14.93mm. Found was a high negative correlation ($r=-0.74249$) between the Berg scale results and forwards-backwards gravity center inclination. It shows that the higher was the Berg balance scale result – the lower was the gravity center inclination.

Table V. Stabilometric platform – comparison of examined group with testing group
Tabela V. Platforma stabilometryczna – porównanie grupy badanej z grupą kontrolną

Test	Examined group /Grupa badana	Testing group /Grupa kontrolna
Eyes closed /Oczy zamknięte	18.23	11.32
Eyes opened /Oczy otwarte	16.15	1.63
Test χ^2	0.0294	

Table VI. Comparison of platform test results before and after rehabilitation
Tabela VI. Zestawienie wyników badania na platformie przed i po rehabilitacji

Test	First day /Pierwszy dzień	Last day /Ostatni dzień
Eyes closed /Oczy zamknięte	18.23	17.56
Eyes opened /Oczy otwarte	16.15	9.53
Test χ^2	0.3467	

Discussion

Body balance is determined as the organism's ability to maintain an upright posture without assistance of anybody else, excluding also uncontrolled falling. Such an ability is hard to diagnose, because the majority of tests applied in medicine give its incomplete image. The balance is a state which can be regained during or after certain activities. The most thorough tests of body balance disorders are surely the examinations using the stabilometric platform, but the measuring equipment is too expensive to be widely available [11-13].

Balance disorders, resulting from the illness progress, can significantly hinder the patient's daily routine. The stabilographic parameters obtained in the frontal plane are notably lower than those taken in the sagittal plane, with no significant difference whether they were taken by the patient with eyes opened or closed. The reason was that in the frontal plane a person has two points of support – the legs, whereas in the sagittal plane – only one; that is why the inclination obtained much higher values.

The research conducted by Mraz on the stabilometric platform enables us to assess the probability of the occurrence of the balance disorders in MS patients on the basis of the area of the stabilogram. That, in turn, gives the possibility of an early introduction of the kinesiotherapeutic procedures during the asymptomatic period [14]. The possibilities of improving the fitness and body balance in MS patients are confirmed by the tests conducted by Wiles, Rietberg et al. [15, 16]. Other scientists, Kalron and Achoron, indicated an issue significant for balance maintaining ability in MS patients, especially those who experienced at least one fall. According to their results, that issue may significantly influence the length of the path (COP – center of pressure) on the platform [17]. Interesting studies were carried out by Frevel and Mäurer. The researchers compared the impact of hippotherapy and Internet-based home training (balance, postural control and strength training) twice a week for 12 weeks. Both groups showed comparable and highly significant improvement in static and dynamic balance capacity [18]. Cattaneo at al. showed that 3 weeks of balance rehabilitation for motor and sensory strategies seemed to improve the dynamic and static balance in MS patients [19]. Also a combined strength and balance training twice a week for 8 weeks significantly improved balance in MS as compared with the control group, in the research conducted by Cakt at al. [20].

The results of the Berg balance tests show that only 13% of the patients are able to manage on their own. The same scale was applied also by Smedal et al., Cattaneo et al., and Silkwood-Sherer and Warmiber. They used it to evaluate physiotherapeutic procedures,

applying balance exercises which improved the MS patients' body balance [19, 21, 22].

For the patients suffering from MS extremely important are their surroundings and every day routine. All tested women laid great emphasis on their health, medical care, living conditions and architectural barriers. Moral support from their family and friends, as well as their emotional mood, were considered very important. On the other hand, the other people's opinions were of little importance for 60% of the tested patients, whereas for 40% they were considered as moderately important. Only 30% of them defined the degree of satisfaction with their family or friends' support as very good. None of the tested women were pleased with their job, education, emotional state or their own image – mostly they were slightly discontented. Noticed was a bond between the ability of maintaining balance and the quality of life. Those women who defined their own image, job satisfaction and life quality resulting from those factors as low, also revealed higher inclinations during the stabilometric platform tests.

The works of Schwartz et al. proved that within 5 years the life quality of tested patients did not change despite the deterioration of their clinical state. It shows that the disease symptoms are not always correlated with the life quality deterioration [23]. Thus the functional estimation and the life quality evaluation should be analyzed separately. The research of Rość and Kowalik indicated that limitation of locomotor abilities does not seriously determine psychical state of the patients if they are able to accept their illness, have family support and do not meet any architectural barriers.

Similar results were also obtained by other authors. Vickrey et al. evaluated the life quality using the questionnaire MSQOL-54. He obtained the following results: 48.6 points in physical sphere with 62.9 points in psychical sphere Szafraniec and Czernicki [24-26]. Salgado et al., submitted their MS patients to a 4-month-long "Ananda Yoga" training. Their research proved that this method could improve the patients' fitness and quality of life [27]. Also practicing of Tai-Chi can help. Lau et al. pointed out that it was a safe method in treatment of neurological, rheumatological, cardio-vascular diseases, breast cancer and COPD. Regular practicing of Tai-Chi improves the oxygen efficiency, muscle strength, balance, life quality and mental state in patients [28].

Women suffering from MS sometimes have problems with their sex life. Lew-Starowicz and Rola pointed out a decrease in their sexual needs and disorders in excitability and orgasms. According to them, apart from the nervous system disorders, good partnership is essential as it significantly improves the sexual function and life quality in patients [29].

According to Kumpelf et al., the symptoms influencing the patients' quality of life to the highest degree are the following ones: ataxia (58%), depression (46%), sphincter disorders (46%), faecal incontinence (29%), paresis (37%) and cognitive functions disorders [30].

Conclusions

1. Women with MS have impaired ability to maintain body balance. Rehabilitation process performed accordingly improves balance.
2. The degree of quality of life has an impact on the ability to maintain balance in patients with MS.
3. An accurate evaluation of the patients' condition and functional disorders is the key element in the process of rehabilitation of patients with MS.
4. Rehabilitation should be aimed at improving balance and coordination.

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