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Assessment the Risk of Falls Versus Postural Stability of the Elderly, Using a Stabilographic Platform

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ABSTRACT

Aim: The purpose of this study was to show the characteristics of postural stability in the aging process of elderly people, using the stabilography method and risk assessment of falling occurring in this age group.
Materials and methods: The overall study included 36 people engaged in the therapeutic process in Musculoskeletal Rehabilitation Centre in Krzeszowice ORNR. Their average age was 69,42 (± 7,12) years. The test consisted of unconstrained standing on the stabilograph platform for 30 seconds in different experimental conditions: (1) Unconstrained standing with open eyes, (2) Unconstrained standing with closed eyes, (3) Unconstrained standing with open eyes after 6 revolutions on the Barany's chair.
Results: This research showed that the posture of elderly people is characterized by higher values of displacement/COP lean in the sagittal plane rather than frontal plane.

Furthermore, it demonstrated that limitations in impulses from sensory inputs (vestibular and visual system) result in an increase of oscillations of the stabilogram graphic curve. However, no strong link between the values of individual measurements (stabilogram) and the occurrence of fall was established.
Conclusions: This study showed the usefulness of the stabilography method in describing the stability of the human body. Yet, in order to determine the objectivity of this method, further tests need to be done on larger sample groups and norms regarding people of different ages have to be elaborated. The results obtained in this research might however contribute towards the development of modern accident prevention programs.

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Introduction

The ability to maintain a stable posture and safe locomotion in the ontogenesis is under change with different kind level and direction. The relatively early improvement of the body balance goes into long-term stability after sixty years of age to undergo dynamic changes involutionary[1]. This is the result of significant degenerative processes occurring in the central nervous system but also its peripheral ranges. In atrial organ, as a result of aging, comes to reducing the excitability of the peripheral and sensory function of body position[2]. Then it comes to reducing the level of physical fitness in every manifestation of human motorics. This condition favours the random and uncontrollable situations falls, which may result in serious loss of health or even loss of life[3].

[1] K. Berg, *Clinical and laboratory measures of postural balance in an elderly population,* "Archives of Physical Medicine and Rehabilitation", 1992: Vol. 73, p. 1073–1080; J. W. Błaszczyk, L. Czerwosz*, Stabilność posturalna w procesie starzenia*, „Gerontologia Polska", 2005: Vol. 13,1, p. 25–36.

[2] K. Galus, J. Kocemba, *MSD Podręcznik geriatrii*, Urban & Partner, Wrocław 1999, p. 70–85.

[3] E. Czerwiński, P. Borowy, B. Jasiak, *Współczesne metody zapobiegania upadkom z wykorzystaniem rehabilitacji*, „Ortopedia, Traumatologia, Rehabilitacja", 2006: 4 (6) Vol. 8, p. 380–387; E. Czerwiński, A. Kumorek, A. Milert, P. Borowy, *Przyczyny upadków u kobiet w populacji krakowskiej*, „Ortopedia, Traumatologia, Rehabilitacja", 2008: 10, p. 429–440; J. C. Davis, M. G. Donaldson, M. C. Ashe, K. M. Khan, *The role of balance*

Żurek and Resel examine the consequences of falls in three categories: physical, psychological and socio-economic[4]. Among the physical consequences leading to the patients disability is dominated by fracture (5–6%), most of the proximal femur. It should also be mentioned: injuries in the joints (sprains, dislocations), as well as soft tissue injuries (lacerations, hematomas), and burns. Moreover, the need to immobilize the fracture can cause the development of many diseases and organ systems, including: deep vein thrombosis, pulmonary embolism, dehydration, infections, pressure sores and contractures in the joints. Following these complications, the patient is no longer hospitalized, often becomes dependent on the environment and even die prematurely[5]. As for the effects of mental impairment is calculated self-confidence, deterioration of comfort and well-being, increasing the fear of another incident and the resulting "post-fall syndrome"; leading to a reduction in physical activity. This in turn causes muscle weakness decreased mobility in the joints and impaired self-service capabilities. Secondary impairment of physical function due to deterioration in quality of life associated with the avoidance of leaving home by patients. Thus, in the social sphere, the main problem is isolation and loss of social roles. The collapse may lead to prolongation of hospital stay, and inability to return to an earlier life, which is always associated with increased costs of treatment and care[6]. Stable posture determines movements made by humans. Therefore, an important element of the assessment of physical activity is to assess postural stability. This study classifies patients into groups with the problem of postural instability or a group of people at risk of collapse, determines imbalance and allows you to select the correct therapy and assess the effectiveness of its

and agility training in fall reduction. A comprehensive review, "Eura Medicophys", 2004: 40, p. 211–221.

4 G. Żurek, J. Resel, *Ocena ryzyka upadków osób starszych z problemami neurologicznymi, zamieszkujących w domach pomocy społecznej* „Rehabilitacja w praktyce", 2010: 2, p. 23–25.

5 A. Skalska, M. Fedyk-Łukasik, J. Walczewska, *Upadki w wieku podeszłym – przypadek czy objaw choroby*, „Medycyna Specjalistyczna", 2003: 2 (3), p. 45–51; M. Żak, A. Skalska, T. Ocetkiewicz, *Upadki osób w starszym wieku – ocena zmiany ryzyka dokonywana po roku od upadku,* „Rehabilitacja Medyczna", 2004:8 (3), p. 19–22.

6 R. G. Cumming, G. Salkeld, M. Thomas, G Szonyi, *Prospective study of the impact of fear of falling on activities of daily living*, "Journals of Gerontology Series A: Biological Sciences and Medical Sciences", 200: 55, p. 299–305.

application. One method of dealing with quality control assessment of attitudes is stabilography[7]. Stabilography is a modern, non-invasive and easy to use tool used in the diagnosis and therapy, the specific application is in orthopaedic and neurological diseases. Due to the ease of measurement indicators for the COP is designed to assess the attitude control system, imbalance detection and risk assessment of falls and postural rehabilitation monitoring the impact on the ability to control posture[8].

1. Aim of the research

The assumptions of the research project required from authors formulating two basic research aims. In the first place the description and analysis of changes in parameter values of stabilographs under the influence of interference of sensory inputs (visual organ and balance organ), controlling the standing posture should have been done. Then the risk of falls in older people, maintaining a balance in a standing position, based on changes in the stabilograph image during the test on stabilograph platform were assessed.

2. Material and methods

The study involved 36 subjects aged 60–87 years, admitted for rehabilitation on a daily basis at the Centre for Rehabilitation of Organ Movement in Krzeszowice. Groups of patients undergoing testing had 19 women and 17 men. The average age of study participants was 69,42 years (± 7,12). During recruitment of patients, being held based on the purposeful selection of qualified, persons representing pathological conditions essential for a given age bracket were selected. These were musculoskeletal disorders such as degenerative joint-production of peripheral and spinal arthritis, osteoporosis and condition after joint replacement of peripheral joints, spine pain syndrome, status post-traumatic arthritis (fractures, dislocations, sprains, bruises). In addition, the study allowed people with cardiovascular disease (hypertension, coronary artery disease) stabilized pharmacologically. In order to develop the results of the study group was divided into experimental group (experiencing falls) and control (no falls).

[7] J. W. Błaszczyk, *Biomechanika kliniczna*, PZWL, Warszawa 2004, p. 192–230.

[8] T. Ocetkiewicz, A. Skalska, T. Grodzicki, *Badanie równowagi przy użyciu platformy balansowej- ocena powtarzalności metody*, „Gerontologia Polska", 2006: 14 (1), p. 144–148.

A questionnaire assessing the risk of falls in older people, for whom assumed the form of questionnaires. It consists of 22 questions about fitness and physical activity, difficulty in performing activities of daily living, social-professional activity, the occurrence of complaints from the systems that affect balance, the overall perception of their own health and the characteristics of previous falls – a place of his accession, subjective causes and effects the collapse.

Stabilography – tests performed on the platform balance/tensometric Zebris German production, using computerized measuring system evaluating the distribution of forces. During the experiment used a static module (Stance) software, which allowed to analyze the pressure distribution of the feet on the ground during free standing test and assess the balance of static observing parameters such as location of the center-line pressure on the foot platform settings and load asymmetry (right – left foot, forward – backward). A key component of the measurement of the experiment was to analyze swinging COP. For this purpose, the following parameters were measured:

- *Confidence elipse area* – statokinesiogram area. By combining the boundary lines of the extreme points (plotted by the COP path length) is obtained irregularly shaped polygon;
- *CoF total track lenght* – path length, the total COP path they travelled in a given time (here: 30 seconds), expressed in mm;
- *CoF horizontal deviation* – average COP excursion in the frontal plane (lateral direction) of the point 0, which is calculated geometric center of gravity of the test, expressed in mm;
- *CoF vertical deviation* – average COP excursion in the sagittal plane (towards the anterior-back), expressed in mm; Confidence Elipsewidh – the width of the ellipse of confidence set by moving the COP, otherwise range swinging range, or extreme/maximum deviation of the COP along the X axis (in the lateral direction) from the point 0, expressed in mm;
- *Confidence elipse height* – amount of confidence ellipse area designated by the moving COP, or extreme/maximum deviation of the COP along the Y axis (in the anteroposterior direction of the back), expressed in mm moving COP, or extreme/maximum deviation of the COP along the Y axis (toward the anterior-back), expressed in mm.

The study included three trials, where the patient stayed 30 seconds on the platform in the free standing:

1. Trial – free both legs standing with eyes opened;
2. Trial – free both legs standing with eyes closed (covered);
3. Trial – free both legs standing with eyes opened after 6 turns (in 12s) on Barany'ego chair. Velocity of the turns: 0,5 turns per sec.

3. Analysis of the research results

3.1. Analysis of changes in the stabilographs under the influence of external disturbances of the balance organ

Total value of the COP path in the study group, expressed in mm is presented in Table 1.

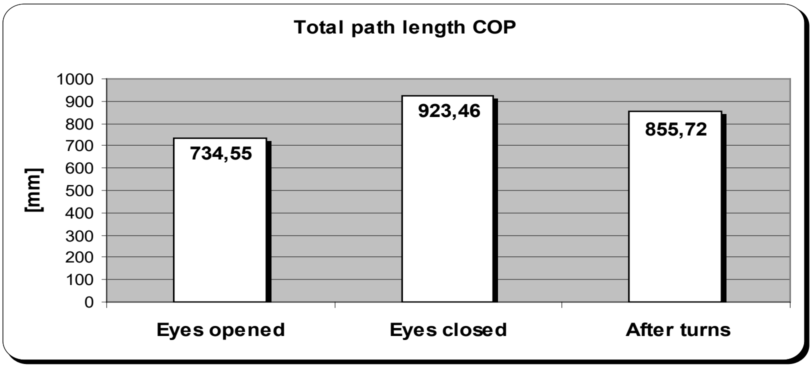
Tab. 1. Total value of the COP path in the study group, expressed in mm [Own elaboration]

	Eyes opened	Eyes closed	After turns
M	734,55	923,46	855,72
sd	144,41	236,00	254,69
min	435,00	415,20	467,00
max	1163,10	1508,00	1421,00

Range projection of the total road excursion of center of gravity of respondents showed large variations: with open eyes in the range 435 – 1163,10 mm, after turning off the visual inspection 415,20 – 1508 mm, while on the cochlea work swinging disorder range from 467 to 1421 mm.

Figure 1 shows the COP path length changes depending on the conditions of the study.

Fig. 1. Averaged values of the total COP excursion path across trials research [Own elaboration]



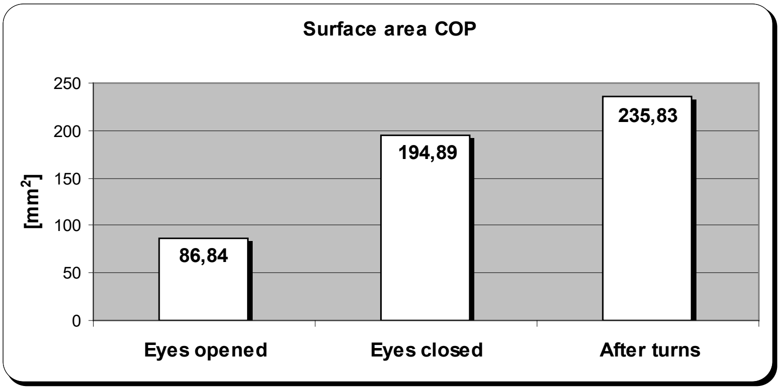
Assuming that the outcome of the first test is 100%, the second attempt (after closing the eyes) the mean value of the total distance the COP excursion increased by 25,72%, while in the third with 16,50%.

Tab. 2. The values of the surface area of the COP in the study group, expressed in mm^2 [Own elaboration]

	Eyes opened	Eyes closed	After turns
M	86,84	194,89	235,83
sd	82,72	205,01	299,70
min	12,50	7,60	11,60
max	326,10	796,60	1358,50

In an attempt to eyes closed there was an increase of the value of 124,5% compared to the first attempt. The surface area plotted by the COP in the third attempt (after the turnover on the Barany`s chair) raised as much as 172% relative to the first (Fig. 2).

Fig. 2. Averaged values of the surface area of the COP in the individual trials research [Own elaboration]



It is worth noting that under visual control off the value of the minimum surface area of the COP has been one of the individuals significantly lower than during the test under normal conditions – without causing interference of external sensory inputs.

The following table presents values of correlation coefficients calculated for the variability of average values.

Tab. 3. The values of correlation coefficients calculated for the variability of average values (path length and total surface area) between the COP attempts (1–3) [Own elaboration]

Measurement parameters	Following trials		
	1–2	1–3	2–3
Total path length COP	0,74*	0,72*	0,55*
Surface area COP	0,65*	0,54*	0,38

Correlation coefficients marked with (*) show a statistically significant relationship at p ≤ 0,05.

Dependence has been demonstrated at a high level of total COP path between the sample with open eyes, and attempt with closed eyes, as well as between the sample with open eyes, and an attempt at speed. Among other attempts at the correlation coefficient is slightly lower.

Average values of deflections in the frontal and sagittal plane are showed in table 4 and 5.

Tab. 4. Average values in the frontal plane deflections in mm [Own elaboration]

	Eyes opened	Eyes closed	After turns
M	3,77	5,52	5,87
sd	1,96	3,11	3,47
min	0,90	0,90	0,90
max	9,30	14,00	14,60

In the second and third attempt increase of the percent in average COP excursion relative to the first trial is at a similar level: with eyes closed it increased by 46,42%, and after disrupted of the vestibular system by 55,7%. Interestingly, the minimum value of the average COP articulation in the coronal plane for each test is at the same level and is 0,90 mm.

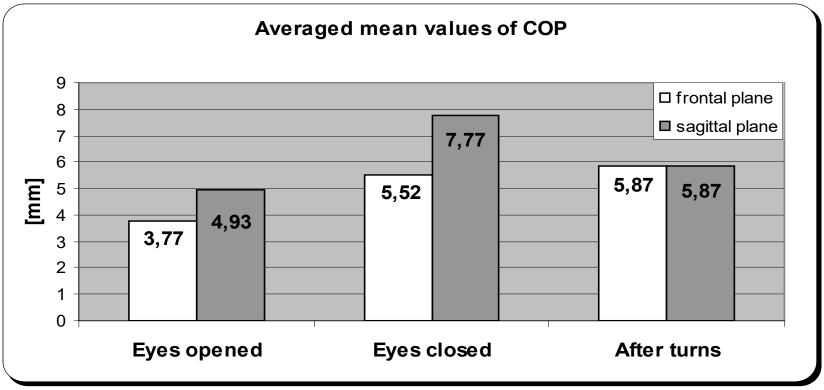
Tab. 5. Average values of deflections in the sagittal plane in mm [Own elaboration]

	Eyes opened	Eyes closed	After turns
M	4,93	7,77	5,87
sd	2,08	3,38	3,52
min	2,30	2,80	2,80
max	11,00	15,00	21,30

In the sagittal plane average values of COP articulation increased: in the test with the eyes closed, by 57%, while in the sample after the turnover of only 19,06% relative the first attempt.

Showed an increase in the average values of deflections in both axes after a disturbance of sensory inputs that control standing posture. It is worth noting that the greatest impact on the growth of deflections in the sagittal plane took off a visual inspection. Strong disorder of balance center most influenced the swing in the frontal plane, but in this test in both axes an equal level of inclinations was reported (Fig. 3).

Fig. 3. Averaged mean values of COP excursion in the individual trials research [Own elaboration]



In an attempt to second and third percent increase average COP excursion is the first attempt at a similar level: with closed eyes is increased by 46,42%, and the disturbance of balance center of 55,7%. The average values of the sagittal plane COP excursion increased: in the sample with the eyes closed by 57%, while turnover in the sample after only about 19.06% compared to the first attempt (Tab. 6).

Tab. 6. The values of correlation coefficients calculated for the variability of average values of COP excursion between the individual trials (1–3)

Analysis plane	Following trials		
	1–2	1–3	2–3
frontal	0,59*	0,55*	0,46
sagittal	0,43	0,57*	0,67*

Correlation coefficients marked with (*) show a statistically significant relationship at $p \leq 0,05$.

3.2. Analysis of the impact of changes in the stabilograph image on the occurrence of falls

The only parameter showing the relationship with the occurrence of the collapse was total COP path. This result indicates a moderate correlation (Table 7).

Tab. 7. The values of correlation coefficients between the values of individual parameters (path length and surface area of the COP) and the onset of collapse [Own elaboration]

Measurement parameter	trial	Fall occurrence
Total path length COP [mm]	1	0,51*
	2	0,20
	3	0,43*
Area surface COP [mm^2]	1	0,37
	2	0,32
	3	0,12

There was no correlation between the front-side and side body inclination and the occurrence of a fall. The only parameter indicating the relationship with the onset of fall turned out to be the way of the COP. This result indicates moderate dependence (Table 8).

Tab. 8. The values of correlation coefficients between the average measurement values at certain levels and the onset of collapse [Own elaboration]

Planes analysis	Fall occurrence		
	Trial 1	Trial 2	Trial 3
frontal	0,38	0,20	0,15
sagittal	-0,23	0,06	-0,14

Negative values mean deflections in the sagittal plane show the randomness of the fall.

Presenting the percentage difference in the size of the individual stabilogram parameters between the experimental group (those who experienced a fall), and control, it was assumed that the result swinging in the control group is 100%. Reduce the value in the experimental group was recorded for a single parameter, average deflections in the sagittal plane. On the basis of comparative analysis for the other parameters were observed to increase the size of the measurement in the experimental group. Specific swinging increase, over 81%, concerned the COP area.

Tab. 9. Differences in rates calculated for various values of the stabilogram parameters in the first attempt (eyes open) between the experimental group (experiencing falls) and controls (without falling) [Own elaboration]

Measurement parameter	Experimental group	Control group	Percentage difference
Total path length COP [mm]	789,84	655,3	↑ 21,90
Surface area COP [mm^2]	103,46	55,88	↑ 85,15
Average inclination in sagittal plane [mm]	4,46	5,60	↑ 20,36
Average inclination in frontal plane [mm]	4,25	3,23	↑ 31,58

4. Discussion

Development of knee-jerk reactions that are essential to maintain upright posture of man, clearly visible is in infancy and the first few years of life. Organ of the central nervous system, which is the vestibular organ, is evolving as one of the first brain structures. It develops already around the sixteenth week of fetus life. To full fitness capacity reaches equilibrium relatively quickly, by various authors between 12 and 16 years old, would then hold for many years in a state of stability. It has been said that we are aware of the manifestation of such a function of the human body when the effects of disorder are disorders of balance multi-centre structures or resulting from the processes involutional. One method of assessing the efficiency of the body balance ability is posturography. In many scientific studies explored the relationship between the size of the deflections of individual parameters and the presence of various stabilogram disturbance of equilibrium. A significant number of scientific reports in question concern the role of capacity and level of its manifestation in sport. It is understood that the specific conditions of certain sports require specific performance from the players balance function. Therefore the issue is still taken to assess the level of efficiency and ability to shape the balance in sports, where the training is the basis for coordinating human motorics sphere[9]. Another aspect of the sports discussion concerns the impact of various levels of manifestation of efforts to body balance ability[10]. There are studies, which indicate that the body has adapted to the effort in conditions of postural responses when the load on a higher level than at the test conditions of resting.

An important range of issues of research with the use of posturografic research is to analyze the level of body balance manifestation off the sense of sight[11]. This analysis led by Henryk Sienkiewicz who finished with a description of body balance in young, healthy and able-bodied people[12]. Sienkiewicz stresses that in the regulation of human posture used afferent information from many sources, mainly: sensomotoric system, vestibular and nerve. Sienkiewicz observations were confirmed in our study. Recalling the external disturbances of sensory inputs for the control of standing by restricting incoming information into the CSN caused the expected im-

[9] F. Asseman, O. Caron, J. M. Cremieux, *Are there specific conditions which expertise in gymnastics could have an effect on postural control and performance?*, "Gait Posture", 2008: 27 (1), p. 76–81; T. Aydin, Y. Yildiz., C. Yildiz, S. Atelsap, T. A. Kalyon, *Proprioception of the ankle: a comparison between female teenage gymnasts and controls,* "Foot Ankle Int", 2002: 23 (2), p. 123–129; A. R. Calavalle, D. Sisti, M. B. L. Rocchi, *Postural trials: expertise in rhythmic gymnastics increases control in lateral direction*, "European Journal of Applied Physiology", 2008: 104 (4), p. 643–649; C. D. Davlin,, *Dynamic balance in high level athletes*, "Perceptual and Motor Skills", 2004: 98 (3), p. 1171–1176.

[10] E. Kioumourtzoglou, V. Derri, O. Mertzanidou, G. Tzetzis, *Experience with perceptual and motor skills in rhythmic gymnasts*, "Perceptual and Motor Skills", 1997: 84 (3), p. 1363–1372; W. Starosta, D. Fostiak, D. Kruczkowski, *Competitors in sport dancing,* [in:] *New ideas in fundamentals of human movement and sport science: current issues and perspectives*: 10th Sport Kinetics Conference Belgrade, Serbia, University Faculty of Sport and Physical Education, 2009, p. 238–241; M. Taniewski, W. Zaporożanow, K. Kochanowicz, D. Kruczkowski, *Ocena czynności układu równowagi sportowców na podstawie badania odruchów przedsionkowo-rdzeniowych i przedsionkowo-ocznych*, „Medycyna Sportowa" 2001, nr 6 (119), p. 227–231; N. Vuillerme, F. Danion, L. Marin, A. Boyadjian, J. M. Prieur, I. Weise, V. Nougier, *The effect of expertise in gymnastics on postural control*, "Neuroscience Letters", 2001: 303 (2), p. 83–86.

[11] J.W. Błaszczyk, *Biomechanika…*, p. 192–230; J. Dornan, G. R. Fernie, P. J. Holliday, *Visual input: It's importance in the control of postural sway*, "Archives of Physical Medicine and Rehabilitation", 1978: Vol. 2 (4); T. Ocetkiewicz, A. Skalska, T. Grodzicki, *Badanie równowagi…*, p. 144–148.

[12] H. Sienkiewicz, *Porównanie przebiegów stabilogramów u człowieka utrzymującego równowagę po wyłączeniu funkcji niektórych receptorów*, „Człowiek i ruch", 2001: 2 (4), p. 39–49.

pairment of balance. This deterioration reflects the stability of a significant increase in the size of each parameter stabilogram. Comparing the ability to body balance maintaining with a full visual inspection, and after it switched off for the surface area of the COP, there were significantly greater percentage increase – up 124,42% than for the other measures stabilogram.

Kuczynski et al. indicates the specific differences between the measured values in samples with the eyes open and closed[13]. In the frontal plane, when you close your eyes amplitude COP displacements increased by 47% in the older group (54–72 years) and 24% in the younger group (29–53 years). Research results Kuczynski permits to conclude that over the years, the stability of equilibrium in the coronal plane is particularly vulnerable to loss of performance. Different measurement results obtained in our study. On their basis, after closing the eyes were slightly greater increase in COP excursion in the sagittal plane than in front. The amplitude of the COP swinging after disabling visual inspection, for the frontal plane was 41%, while the sagittal plane about 9% more. Medium tilt showed similar dependence. In the frontal plane was recorded: 46% and 58% of the sagittal plane.

Specific vestibular organ working dysfunction with kinetic stimulus (turnover in the Barany`s chair) used in the experiment was to enrich knowledge about his role in the system of balance. Submission of the vestibular organ exposure to external interference caused the expected deterioration of balance control, as evidenced by an increase in all core stabilogram during the third attempt. The biggest increase in value under the influence of these disturbances was recorded for the surface area of the COP. The results of their own, on the one hand show an increase in the range s COP winging under the influence of external disturbances, on the other hand, testify to the occurrence of compensatory mechanisms involving the mutual complementarity of sensory systems. Tracing the dynamic changes in the maximum deflections of the COP in the frontal plane, it was observed that the system vestibular disorder causes only a slight increase in the value of this parameter. This reflects the acquisition of its functions by the other circuits that control posture while standing and is a significant proof of the cooperation of these systems. In the present study therefore demonstrated, confirming the results of other authors

[13] M. Kuczyński, E. Dean, A. Jones, *The viscoelastic model of standing balance control: preliminary norms and clinical implications*, "Human Movement", 2002: 1 (5), p. 5–13.

that the scope of the operation of the receptor, despite their large severance, to some extent overlap, which causes the disorder, or even disable one of them leads only to minor imbalances[14]. It is worth noting that on the basis of stabilographic measurement used in the experiment it is possible to determine only the effects of impaired balance control. COP signal does not provide information on what level problems with which the signs of receptor systems on deregulation and what is their cause. Universally recognized indicator of stability is the extent of human COP excursion in the sagittal plane and frontal[15].Numerous research results also confirm that while maintaining a standing position, in individuals over 60 years of age (Which is characterized by reduced stability of the attitude) rocking the COP is significantly higher compared with young, healthy. However, as the notes Blaszczyk increased COP excursion range may not always be the result of impaired postural control system[16]. Often as high amplitude COP swinging is observed even in those very able-bodied. In their studies Slobounov and Newell compared the results with values for stabilograms gymnasts and athletes jumping from the tower to the control group – students of Physical Education[17]. Unexpected, they reported higher values of COP excursion experimental group – individuals trained. Thus, the increased range of involuntary movements of the COP does not necessarily indicate a deterioration of the efficiency of systems controlling the attitude of standing[18]. Lee and Deming by examining the maximum deflection of the body in the sagittal plane in the elderly have come to similar conclusions[19]. They claim as that reported in people in this age group

14 Z. Najsarek, *Analiza reakcji ruchowych stojącego człowieka na narastającą w czasie i utrzymującą się zakłócająca siłę poziomą*, „Człowiek i ruch", 2001: 2 (4), p. 47; H. Sienkiewicz, *Porównanie przebiegów…*, p. 39–49.

15 W. Błach, *Amplituda maksymalnych swobodnych wychyleń ciała zawodników dżudo i studentów AWF w płaszczyźnie strzałkowej*, „Człowiek i ruch", 2001: 2 (4), p. 83–85; M. Golema, *Stabilność pozycji stojącej*, Studia i monografie, AWF, Wrocław 1987, p. 17.

16 J. W. Błaszczyk, *Biomechanika…*, p. 192–230; M. Kuczyński, E. Dean, A. Jones, *The viscoelastic…*, p. 5–13; T. Ocetkiewicz, A. Skalska, T. Grodzicki, *Badanie równowagi…*, p. 144–148.

17 S. Slobounov, K.M. Newell, *Postural dynamics as a function of skill level and task constraints* "Gait&Posture", 1994: 2.

18 H. Sienkiewicz, *Porównanie przebiegów…*, p. 39–49.

19 W. A. Lee, L. Deming, *Corelation between age and the size of the normalized static support base while standing.* Proceedings of the 1987. Annual Meeting of the North American Society of the Psychology of Sport and Psychical activity, 41.

decreased the maximum deflection of the body, are the result of leaving a wider "safety margin"[20]. The same aspect applies to the publication of sheet (2001), who studied the process equivalent of judo athletes. He noted the reduced amplitude deflections (front-rear) and a smaller maximum deflection of the body in the back of judo athletes compared with untrained. Due to the fact that the falls were the most common reason given by the patients treated in ORNR in Krzeszowice, it was decided to examine whether there is a relationship between the occurrences of falls, and increased the amplitude of fluctuations in each parameter as an expression of impaired stabilogram postural control. Blaszczyk and Czerwosz of key importance in the regulation of standing attribute distances as they move the COP[21]. Evidenced by the nearly twenty-second – the percentage difference in the COP path length between the experimental group (those who have suffered the fall), and controls. Statistical analysis in this study showed that the path length is the most sensitive indicator of stabilogram postural stability.

In summary, the results of this study indicate the usefulness of the application of stabilograph stability in the characteristics of the human body. Stabliographic method that was used in this experiment is excellent for the diagnosis, allowing early detection of disorders of balance. Becomes the basis for a modern program of risk assessment and prevention of falls. No standards describing the balance of the body in an upright position, which makes it difficult to assess whether the results are within physiological limits or exceed them to the symptom. Still another and perhaps even more fundamental problem is the origin and nature of these symptom. A symptom, after all, is a fragment of behavior that points to a state of the brain. If the fragment points to a disrupted phase in the mind/brain state, then behavior as a whole is a symptom or expression of the brain state as a whole. This implies that the relation of the symptom to the disturbed fragment is a nucleus of the relation of any behavior to the mind/brain state that generates it. The symptom is only pathological when it is deviant. In neuropsychology, a symptom is a fragment of unexpected (deviant) performance in an otherwise normal behavior[22].

[20] J. W. Błaszczyk, *Biomechanika…*, p. 192–230.

[21] J. W. Błaszczyk, L. Czerwosz, *Stabilność …*, p. 25–36.

[22] J. W. Brown, M. Pąchalska, *The symptom and its significance in neuropsychology*, "Acta Neuropsychologica", 2003: 1 (1), p. 1–11.

The results obtained in this study need to be verified on a larger group of respondents, while remaining a valuable resource and a basis for further research on postural stability.

Conclusions

Stabliographic method allows precise measurement of gravity wave displacements (COP), its interpretation is difficult-COP signal does not give insight into the actual mechanisms of balance.

Standing posture in the elderly (over 60 y.o.) is characterized by involuntary movements of larger values of the COP in the sagittal plane than in the frontal plane.

Reducing the flow of information from any of the sensory inputs (vestibular layout and visual) significantly impair the process of control in the elderly.

The results obtained in this study could provide a source for a modern program of prevention of falls. To determine the objectivity of stabliographic in the risk assessment of falls, must be verified to more numerous sample inference researches. It should also develop standards for the assessment of human balance for different age groups of coherent developmental characteristics.

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