In Vitro / J. Murray, J. Barbara, S. Dunkley [et al.] // Blood. – 1997. – V. 90 (7). – P. 2772-2783.

36. Regulation of TNF mediated antiapoptotic signaling in human neutrophils: role of δ-PKC and ERK1/2. / L.E. Kilpatrick, S. Sun, D. Mackie et al // J. Leukoc. Biol. – 2006. – V. 80. – P. 1512-1521.

37. Sadallah S. Ectosomes relased by human neutrophils are specialized functional units / S. Sadallah, A. Hefti // J. Immunol. – 1999. – V. 163. – P. 4564-4573.

38. Toso, a functional IgM receptor, is regulated by IL-2 and T cells / Y. Murakami, S. Narayanan, S. Su [et al.] // J. Immunol. – 2012. – V. 189(2). – P. 587-597.

39. Type I and type II interferons delay human neutrophil apoptosis via activation of STAT3 and up-regulation of cellular inhibitor of apoptosis / E. Sakamoto, F. Hato, T. Kato [et al.] // J. Leukoc. Biol. – 2005. – V. 78. – P. 301-309.

40. Wei J. Autophagy regulates endoplasmic reticulum homeostasis and calcium mobilization in T-lymphocytes / J. Wei, P.H. Heather, L. Qi-Jiug // J. Immunol. – 2011. – V. 186(3). – P. 1564-1574.

T.P. Shiryaeva, A.V. Gribanov, D.M. Fedotov, O.A. Rumyantseva

EVALUATION OF PARAMETERS OF THE DYNAMIC COMPONENT OF POSTURAL BALANCE IN ELDERLY WOMEN

DOI 10.25789/YMJ.2020.72.07

The aim of the study was to develop centile tables to assess basic parameters of the dynamic components of the postural balance in women 60-74 years old. Three groups of women aged 60-64 years, 65-69 years, and 70-74 years, with a total number of 186 people, were examined. Evaluation of main indicators of the postural balance was carried out using the computer stabilometric complex "Balance Manager". The presented standards will help to increase the information content of research and objective analysis of the results obtained, as well as to evaluate the effectiveness of the implementation of measures to maintain normal, safe walk or prevention of mobility restriction.

Key words: dynamic component of postural balance, women, elderly age, centile grade.

Introduction. Domestic and international studies have shown that the main component of active longevity is the preservation of autonomy and mobility in the elderly. In order to minimize and prevent the loss of an independent, autonomous existence, specialists working with older people should timely determine the level of risk that a future decrease in mobility can predict [2, 4, 6, 7]. The analysis of walking is a widely used indicator of the effectiveness of the functioning of lower extremities in particular, and the postural balance as a whole [3, 5, 6, 9, 10]. Changing the main parameters of a dynamic component of the postural balance is a clear indicator of the preservation of the dynamic component of the postural balance, since they are the most sensitive to future changes in the functional state of the body of the elderly women. However, in modern domestic literature data there is no information about standards for evaluating the main indicators of the dynamic component of the postural balance in elderly women [1, 8, 11-15]. The purpose of the study was to develop centile tables for evaluating the main parameters of the dynamic components of the postural balance in women 60-74 years old.

Materials and research methods. A cross-sectional study was conducted with the informed consent of participants. The study involved 186 women, aged 60-74 years, who were divided into age groups: 60-64 years old - 61 people (average age - 62.8 ± 1.3 years), 65-69 years old - 63 people (average age - 67.8 ± 1.8 years), 70-74 years - 62 people (average age - 73.1 ± 1.1 years). All women in the course of the study were mobile and did not use additional means of support when walking. The following exclusion criteria were considered: a history of strokes, dementia, being registered in a neuropsychiatric dispensary, traumatic brain injuries, acute and chronic diseases during the exacerbation period, as well as permanent residents in nursing homes.

The evaluation of the main parameters of the dynamic component of the postural balance was carried out using the Balance Manager computer stabilometric complex and included the following tests and parameters: Sit to Stand test (Weight Transfer Time, Rising Index, Sway Velocity), Walk Across (Step Width, Step Length, Speed), Tandem Walk (Step Width, Speed, End Sway), Step - Quick Turn (Time (with left and right legs), Sway (with left and right legs)), Step – Up and Over (Lift Up Index (with left and right legs), Movement Time (with left and right legs), Impact Index (with left and right legs)) [1-3].

Statistical processing of the obtained data was carried out using the application package SPSS 21.0 for Windows. For each of the studied indicators, the distribution of signs on normality was assessed using the Shapiro – Wilk criterion. For each of the studied indicators, arithmetic means (m), standard deviations (s), and values equal to 10, 25, 50, 75, and 90 centiles in each of the age groups were calculated.

Results and discussion. Tables 1-3 show the centile distribution of the main parameters of the dynamic component of the postural balance in women of the studied age groups, namely 60–64 years old, 65–69 years old, 70–74 years old. As a result of the data analysis with increasing age, in all the studied groups there is a uniform offset of median values of

SHIRYAEVA Taisia Petrovna – researcher of the Laboratory of Physiology of Muscular Activity and Physical Education, Institute of Age Physiology of the Russian Academy of Science; Junior Researcher, Institute of Biomedical Research, Northern (Arctic) Federal University named after M.V. Lomonosov, e-mail: taisia.moroz@yandex.ru; +79095538101, **GRIBANOV Anatoliy Vladimirovich** – Honored Scientist of the Russian Federation, doctor of Medical Sciences, professor, chief researcher of the Laboratory of Comprehensive Studies of Adaptation Processes, Institute of Age Physiology of the Russian Academy of Science; professor of the Department of Human Biology and Biotechnical Systems, Northern (Arctic) Federal University named after M.V. Lomonosov, e-mail: a.gribanov@narfu.ru. 8 (8182) 21-61-00, **FEDOTOV Denis Mikhailovich** – candidate of Medical Sciences, associate professor of the Department of Hygiene and Medical Ecology, Northern State Medical University; Associate Professor of the Department of Technosphere safety, Northern (Arctic) Federal University named after M.V. Lomonosov, e-mail: doctorpro@yandex.ru; +79009136215, **RUMYANTSEVA Olga Anatolievna** – candidate of Pedagogical Sciences, associate professor of the Department of Sports Disciplines, Northern (Arctic) Federal University named after M.V. Lomonosov, e-mail: o.rumyantseva@narfu.ru; 8 (8182) 21-61-00

the dynamic component indicators of the postural balance, demonstrating a decrease in its quality .

For the visual analysis of the data, we compared and evaluated the dynamics of changes in the main indicators of the postural balance in groups of women 60-64 years old and 65-69 years old, and between groups of 65-69 years old and 70-74 years old.

In 'Sit to Stand' test we found that the median of the Weight Transfer Time indicator in the group of women 65-69 years compared to the group of 60-64 years increased in 2.2%, and after that in 6.5% in group 70 -74 years old. The average value of Rising Index in the group of 65-69 years old decreased by 16.7%, and in the group of 70-74 years old - by 4.4%. Median of Sway Velocity increased in 1.4% and in 6.0% with increasing age in the groups.

When analyzing Walk Across test the Step Length decreased with age in 5.7% and in 9.7%, and Speed decreased in 7.9% and in 1.1% in the groups of 65-69 years old and 70-74 years old, respectively. In turn, the Step Width increased with age in 0.8% and in 1.8%, respectively, in the studied groups.

The median values in the performance of the Tandem Walk test showed the greatest shift of decreasing of the postural balance quality. Thus, the average Step Width increased with age in 21.7% and in 8.0%, and the End Sway in 25.8% and in 8.4%, respectively. The median Speed decreased from group to group by 10.0% and 3.8%.

When analyzing the Step - Quick Turn test, the median values of all the studied parameters increased with aging. The Turn Time to the left and right legs increased in 19.8% and in 22.4%, and in 5.9% and in 8.4%, respectively. The Sway during a turn from the left and right legs increased in 7.8% and in 6.9%, and in 5.6% and in 11.1%.

In the Step – Up and Over test we found a decrease in the median of the Lift Up Index from the left and right legs in 2.5% and in 10.3%, and in 1.2% and in 8.2% in the age groups 65-69 and 70- 74 years old, respectively. In terms of Movement Time from the right and left legs, the median values increased from group to group and increased in 6.9% and in 7.8% for the left leg and in 7.8% and in 5.2% for the right leg. The median Impact Index increased with age in 1.7% and in 10.8% for the left leg and in 8.3% and in 12.8% for the right leg.

Earlier studies have shown that in women aged 60-69 years, there is an almost uniform decrease in the indicators of the dynamic component of postural balance: step length, movement speed, quality of the performance of complex coordination and complex motor acts, as well as an increase in step width and final oscillation during tandem walking. At the same time, there is an increase in the number of significant correlations between these indicators, which indicates the preservation of the functional state of the body at a certain level, as a manifestation of compensatory and adaptive reactions. Characteristic of women aged 70-74 years is a sharp decrease in the indicators of the dynamic component of postural balance with a simultaneous decrease in the number of significant correlations, which can be considered as age-related disadaptation changes in the elderly body. It is also noted that the Step/step test is recommended for rapid diagnosis of postural balance disorders, since it is the most sensitive to age-related changes occurring in the elderly body [1-3]. For a more visual representation of the percentile distribution, we have

Table1

Percentile distribution of the main parameters of the dynamic component of the postural balance in women aged 60–64 years

Parameters		Percentile				
Tests		10	25	50	75	90
Sit to Stand	Weight Transfer Time, (s)	0.23	0.31	0.45	0.54	0.70
	Rising Index (cm/s)	11.00	13.00	18.00	22.00	24.00
	Sway Velocity (cm/s)	2.34	2.93	3.60	4.40	4.96
Walk Across	Step Width (cm)	10.51	11.90	13.50	15.00	15.84
	Step Length (cm)	50.60	53.73	58.60	64.90	76.72
	Speed (cm/s)	76.20	80.40	86.00	96.50	105.76
Tandem Walk	Step Width (cm)	5.41	6.17	7.00	7.80	10.02
	Speed (cm/s)	21.52	23.80	29.33	34.10	38.83
	End Sway (cm/s)	3.20	3.70	4.73	5.93	7.38
Step-Quick Turn	Time Left (s)	0.72	0.98	1.31	2.06	2.51
	Time Right (s)	0.79	0.99	1.35	1.65	2.08
	Sway left (cm/s)	14.54	17.80	25.97	34.80	39.60
	Sway Right (cm/s)	16.16	18.30	24.30	30.10	34.82
Step-Up and Over	Lift Up Index Left (cm/s)	29.00	35.00	40.00	50.00	57.80
	Lift up index right (cm/s)	30.76	37.00	43.00	47.00	57.80
	Movement Time Left (s)	1.15	1.22	1.44	1.71	1.84
	Movement Time Right (s)	1.09	1.21	1.42	1.57	1.76
	Impact Index Left (cm/s)	34.00	46.00	59.00	77.00	98.60
	Impact Index Right (cm/s)	35.00	45.00	54.00	69.00	96.00

Table2

Percentile distribution of the main parameters of the dynamic component of the postural balance in women aged 65–69 years

Parameters		Percentile				
Test		10	25	50	75	90
Sit to Stand	Weight Transfer Time, (s)	0.24	0.33	0.46	0.55	0.73
	Rising Index (cm/s)	11.00	12.00	15.00	21.75	29.20
	Sway Velocity (cm/s)	2.67	2.75	3.65	4.44	4.97
Walk Across	Step Width (cm)	8.94	11.99	13.61	15.22	16.25
	Step Length (cm)	43.15	47.18	55.29	62.07	73.62
	Speed (cm/s)	65.01	74.20	79.19	87.85	94.79
Tandem Walk	Step Width (cm)	5.97	6.90	8.52	10.08	12.89
	Speed (cm/s)	18.88	22.03	26.40	34.70	39.55
	End Sway (cm/s)	3.79	4.61	5.95	7.81	9.01
Step-Quick Turn	Time Left (s)	0.91	1.07	1.56	2.22	2.90
	Time Right (s)	0.74	1.05	1.43	1.90	2.61
	Sway left (cm/s)	15.12	21.48	28.00	34.88	41.60
	Sway Right (cm/s)	16.28	19.19	25.65	35.12	37.24
Step-Up and Over	Lift Up Index Left (cm/s)	28.90	33.25	39.00	48.00	55.10
	Lift up index right (cm/s)	28.90	34.50	42.50	46.23	55.10
	Movement Time Left (s)	1.21	1.35	1.54	1.84	2.01
	Movement Time Right (s)	1.20	1.35	1.53	1.66	2.12
	Impact Index Left (cm/s)	38.80	49.50	60.00	79.75	98.20
	Impact Index Right (cm/s)	36.30	47.25	58.50	74.50	98.90

Table3

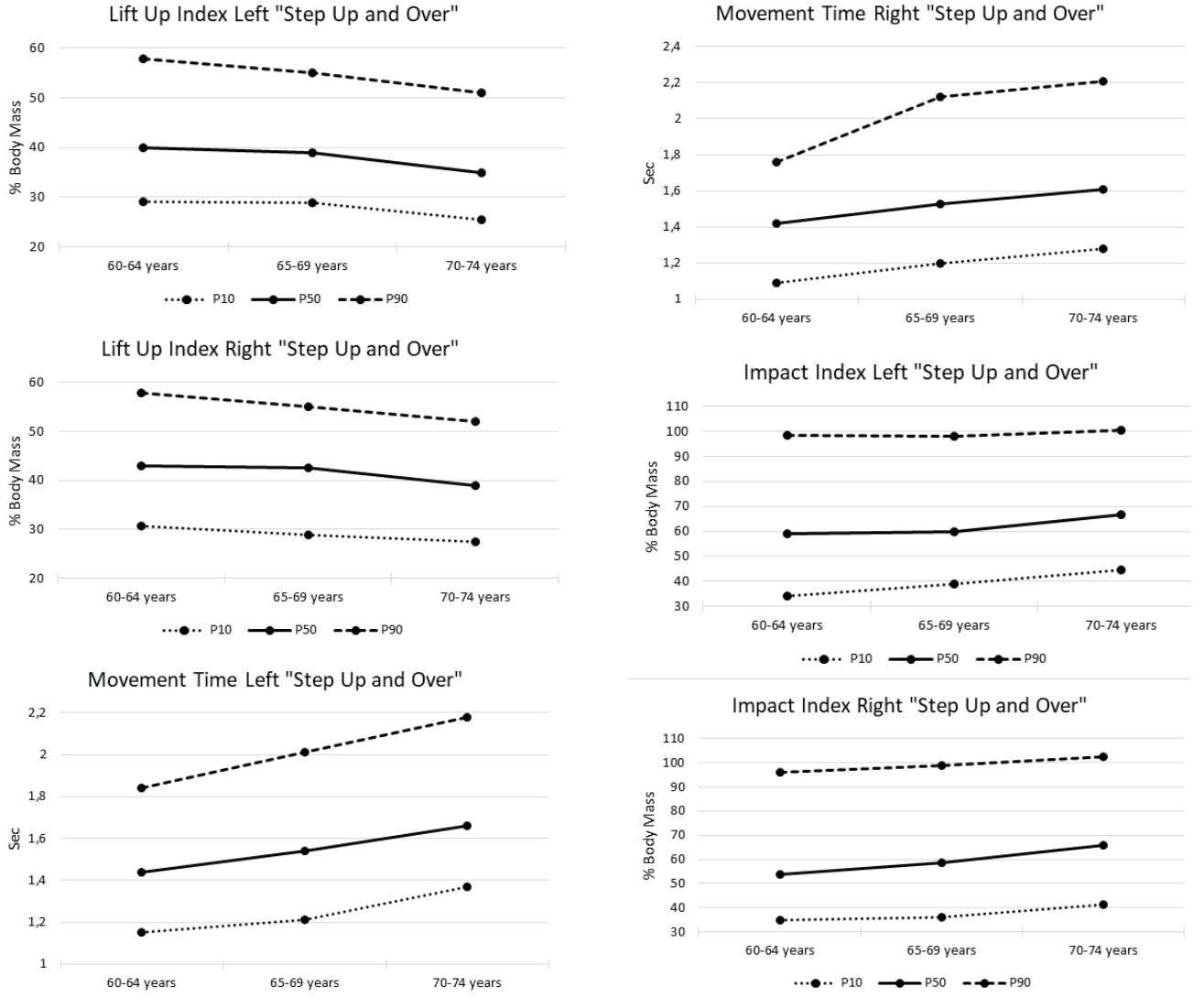
Percentile distribution of the main parameters of the dynamic component of the postural balance in women aged 70-74years

Parameters		Percentile				
Test		10	25	50	75	90
Sit to Stand	Weight Transfer Time, (s)	0.26	0.34	0.49	0.65	0.79
	Rising Index (cm/s)	8.00	11.75	14.34	21.00	29.50
	Sway Velocity (cm/s)	2.25	2.88	3.87	4.53	4.99
Walk Across	Step Width (cm)	8.70	12.23	13.86	15.46	16.87
	Step Length (cm)	40.52	45.32	49.95	57.93	63.90
	Speed (cm/s)	58.57	71.59	78.30	87.23	93.38
Tandem Walk	Step Width (cm)	6.05	7.10	9.20	10.82	15.09
	Speed (cm/s)	17.83	20.13	25.39	35.18	41.05
	End Sway (cm/s)	4.07	5.22	6.45	8.23	9.39
Step-Quick Turn	Time Left (s)	0.95	1.23	1.91	2.71	3.19
	Time Right (s)	0.71	1.22	1.55	2.30	3.09
	Sway left (cm/s)	20.25	24.89	29.95	36.55	46.34
	Sway Right (cm/s)	18.02	21.18	28.50	35.43	38.25
Step-Up and Over	Lift Up Index Left (cm/s)	25.50	30.00	35.00	44.25	51.00
	Lift up index right (cm/s)	27.50	33.75	39.00	45.25	52.00
	Movement Time Left (s)	1.37	1.45	1.66	1.93	2.18
	Movement Time Right (s)	1.28	1.42	1.61	1.89	2.21
	Impact Index Left (cm/s)	44.50	55.00	66.50	86.00	100.50
	Impact Index Right (cm/s)	41.50	55.00	66.00	80.00	102.50

constructed curves of the stabilometric indicators of this particular test, which are presented in figure 1. The choice of centiles was determined by their significance for the diagnosis of disorders in the parameters of physical development of newborns; thus, a stabilometric indicator less than the value of the 10th centile for the corresponding age group is treated as low, and one that exceeds the value of the 90th centile is treated as high .

Such timely evaluation of the dynamic component of the postural balance will undoubtedly prevent serious disorders and, as a result, maintain mobility and promote active longevity of women in elderly age.

Thus, the presented standards, developed on the basis of assessing the state of the dynamic component of the postural balance in older women, will help to improve the quality of research and analysis of the results, as well as help to develop measures to maintain normal,



– Curves of the indicators Lift Up Index, Movement Time and Impact Index with left and right legs of the "Step Up and Over" Test in women 60-74 years old. Note: P-centile.

safe walking or prevent mobility restrictions. Screening by using the developed tables can provide practitioners with a quick and easy way to detect a decrease in the quality of the dynamic component of the postural balance in older women, and to determine the effectiveness of implementing programs to maintain active longevity. However, it should be noted that the presented standards were developed on the basis of a study of a sample of elderly women living in the European North of Russia, using the example of the Arkhangelsk region. As part of a further study, it is necessary to develop similar regulatory data for males and expand the scope of the study to include elderly people living in other regions of Russia.

Conclusion. Thus, with increasing the age, in all the studied groups there is a uniform shift in the median values of the indicators of the dynamic component of the postural balance, which demonstrates the decrease in its quality. The timely assessment of the dynamic component of the postural balance will undoubtedly prevent serious violations of the postural balance, and, as a result, maintain mobility and promote active longevity of women in old age. It is necessary to develop similar regulatory data for males and expand the scope of the study to include elderly people living in other regions of Russia.

The study was carried out with the financial support of the Government of the Arkhangelsk Region (competition "Young Scientists of Pomorie") in the framework of the scientific project No. 10-2020 "Postural deficiency as an indicator of age-related compensatory-adaptive changes in the body of elderly people living in the Arctic Region of the Russian Federation".

References

1. Мороз Т.П. Особенности проявления синдрома падений у женщин пожилого возраста при стабилометрическом исследовании / Т.П. Мороз, А.В. Демин // Вестник Северного (Арктического) федерального университета. Серия: Медико-биологические науки. – 2016. – № 2. – С. 25-30. [Moroz T.P. Features of the manifestation of the syndrome of falls in elderly women with a stabilometric study / T.P. Moroz A.V. Demin // Bulletin of the Northern (Arctic) Federal University. Series: Biomedical Sciences. – 2016. – №. 2. – P. 25-30. (In Russ.)] DOI: 10.17238/issn2308-3174.2016.2.25

2. Функциональное состояние динамического компонента постурального баланса у женщин пожилого возраста и влияющие на него факторы / Т.П. Ширяева, В.И. Торшин, А.В. Грибанов [и др.] // Экология человека. – 2020. – № 3. – С. 10-15. [The functional state of the dynamic component of the postural balance in elderly women and the factors influencing it / T.P. Shiryaeva, V.I. Torshin, A.V. Gribanov [et al.] // Human Ecology. –2020. – №. 3. – P. 10-15. (In Russ.)] DOI: 1033396 / 1728-0869-2020-3-10-15

3. Ширяева Т.П. Факторная модель динамического компонента постурального баланса у женщин с различным индексом массы тела / Т.П. Ширяева, Д.М. Федотов // Журнал медико-биологических исследований. – 2019. – Т.7. №4. – С. 464-471. [Shiryaeva T.P. A factor model of the dynamic component of postural balance in women with different body mass index / T.P. Shiryaeva, D.M. Fedotov // Journal of biomedical research. – 2019. – Vol.7. №4. – P. 464-471. (In Russ.)] DOI: 10.17238/issn2542-1298.2019.7.4.464

4. BTrackS Balance Test for concussion management is resistant to practice effects / M.C. Hearn, S.S. Levy, H.S. Baweja [et al.] // Clin J Sport Med. – 2018. – Vol.28. – P. 177–179.

5. Burns E.B. The direct costs of fatal and non-fatal falls among older adults – United States / E.B. Burns, J.A. Stevens, R.L. Lee // J Safety Res. – 2016. –№58. – P. 99–103.

6. Goble DJ Normative data for the BtrackS Balance Test of postural sway: results from 16,357 community-dwelling individuals who were 5 to 100 years old / D.J. Goble, H.S. Baweja // Phys Ther. – 2018. – Vol.98. – P.779–785.

7. Increased postural sway during quiet stance as a risk factor for prospective falls in community-dwelling elderly individuals / J. Johansson, A. Nordstrom, Y. Gustafson, [et al.] // Age Ageing.– 2017. – Vol. 46. – P. 964–970.

8. Lee H.H. Prediction of poststroke falls by quantitative assessment of balance / H.H. Lee, S.H. Jung // Ann Rehabil Med. – 2017. – Vol. 41. – P. 339–346.

9. Loss of peripheral sensory function explains much of the increase in postural sway in healthy older adults / E. Anson, R.T. Bigelow, B. Swenor [et al.] // Front Aging Neurosci.– 2017. – V 9. – 202.

10. Low D.C. Effectiveness of exercise interventions to improve postural control in older adults: a systematic review and meta-analyses of centre of pressure measurements / D.C. Low, G.S. Walsh, M. Arkesteijn // Sports Med. – 2017. – Vol. 47. – P.101–112.

11. Melzer I. A retrospective analysis of balance control parameters in elderly fallers and non-fallers / I. Melzer, I. Kurz, L.I. Oddsson // Clin Biomech. – 2010. – Vol. 25. – P. 984–988.

12. Mobility in association with anxiety and quality of life in middle-aged and older female fallers and non-fallers / T.P. Shiryaeva, D.M. Fedotov, A.V. Gribanov [et al.] // Russian Open Medical Journal. – 2020. – Vol. 9. – e0212.

13. Morrison S. Deficits in medio-lateral balance control and the implications for falls in individuals with multiple sclerosis / S. Morrison, C.A. Rynders, J.J. Sosnoff // Gait Posture. – 2016. – Vol.49. – P.148–154.

14. O'Connor S.M. Validating the BTrackS Balance Plate as a low cost alternative for the measurement of sway-induced center of pressure / S.M. O'Connor, H.S. Baweja, D.J. Goble // J Biomech. – 2016. – Vol.49. – P. 4142–4145.

15. Postural stability and history of falls in cognitively able older adults: the Canton Ticino study / A. Merlo, D. Zemp, E. Zanda [et al.] // Gait Posture. – 2012. – Vol. 36. – P. 662–666.