VYVÁŽENOST TĚLESNÁ, ENERGETICKÁ, A SOCIÁLNÍ V ŽIVOTĚ SENIORŮ

PHYSICAL, ENERGETIC, AND SOCIAL BALANCE IN THE LIFE OF SENIORS

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Abstract

The ability of physical balance is considered as a key factor in preventing falls and subsequent injuries in the elderly. With regard to balance in the global concept of life, balance evaluation leads to an operational holistic definition of physical balance. The aim of the study is to analyze the predictive components and determinants of overall physical balance, including gait balance in seniors aged sixty five years and older in the context of energy and social balance aspects in seniors aged sixty five years and over. The survey included 500 seniors aged 65 years and older selected by stratified randomized sampling from all regions of the Czech Republic. In the monitored group of seniors there were 234 males (age mean: $74.5 \text{ SD} \pm 7.74$) and 266 females (age mean: $76.9 \text{ SD} \pm 7.23$). Selected methods of "Medical anamnesis", "Anamnestic self-assessment", "Functional anthropological examination", "Tinetti Balance Assessment Tool", Short Form Health Survey (SF-36) were used for diagnostics. Multivariate dimensional regression, such as the orthogonal latent structure projection (OPLS) method, was chosen for statistical evaluation. The correlation analyses of the Tineti summary balance score and the results of Anamnestic Self-assessment, anthropometric parameters and psychosocial indices in relation to gender are presented. SF-36 items, positively or negatively correlate with the physical balance performance of seniors, are discussed. Functional anthropological indicators significant to the balance ability were analyzed. Use of analysics and psych pharmaceuticals, has a significant negative impact on both social balance and the mental health score. Also, high BMI and body fat percentage negatively correlate with social balance.

Keywords: seniors; physical balance; energy balance; social balance; well-being

Souhrn

Schopnost fyzické rovnováhy je považována za klíčový faktor při prevenci pádů a následných zranění starších osob. Pokud jde o rovnováhu v globálním pojetí života, vede hodnocení rovnováhy k funkční holistické definici fyzické rovnováhy. Cílem předložené studie je analyzovat determinanty tělesné, energetické a sociální rovnovážnosti u seniorů ve věku 65 let a starších. Výzkumného šetření se zúčastnilo 500 seniorů ve věku 65 let a starších, vybraných stratifikovaným randomizovaným výběrem ze všech regionů České republiky. v monitorovaném souboru seniorů bylo 234 mužů (věkový průměr: 74,5 SD \pm 7,74) a 266 žen (věkový průměr: 76,9 SD \pm 7,23). K diagnostice byly použity vybrané metody: "Lékařská anamnéza", "Anamnestické sebeposouzení", "Funkční antropologické vyšetření", "Tinettiové balanční škála", "Dotazník kvality života SF-36". Pro statistické vyhodnocení byla zvolena vícerozměrná regrese s redukcí rozměrů, jako je metoda ortogonální projekce na latentní strukturu (OPLS). Jsou prezentovány korelační analýzy souhrnného skóre rovnováhy Tinetti a výsledky anamnestického sebeposouzení, antropometrických parametrů a psychosociálních ukazatelů ve vztahu k pohlaví. Diskutovány jsou položky SF-36, pozitivně nebo negativně korelované s výkonem fyzické rovnováhy seniorů. Byly analyzovány funkční antropologické prediktory signifikantní pro fyzickou rovnováhu. Užívání analgetik a psychiatrických léčiv má signifikantní negativní dopad na sociální rovnováhu i na

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skóre duševního zdraví. Také vysoké procento BMI a tělesného tuku negativně koreluje se sociální rovnováhou.

Klíčová slova: senioři; tělesná vyváženost; energetická vyváženost; sociální vyváženost; well-being

Introduction

The ability to maintain body balance is considered as a key factor in preventing falls and subsequent injuries in the elderly (Lafortune, Balestat, 2007; WHO, 2017; Değer, Saraç, Savaş, & Akçiçek, 2019). The population of the European Union is growing at the age of sixty five and over. According to current forecasts according to Eurostat (2019), by 2025, 20% of Europeans will live at the age of sixty five and over, with a particularly rapid increase in the number of people over the age of eighty. The age sixty five years corresponds with the senior EU definition, in which the term "senior" is defined as a person aged sixty five and over, with defined pension, social security and healthcare rights (EC, 2016). Authors (Gillespie, et al, 2004; Crimmins, Preston, Cohen, 2010; Wang et al., 2019) report that approximately 30% of people aged sixty five years and over experience at least one fall per year, while in institutional care the percentage of seniors aged sixty five and over with fallen falls is higher. One in ten falls leads to a fracture and one fifth of the falls requires hospital medical care. Any fall can cause health problems affecting the physical, mental and social quality of life.

Psychosocial consequences of seniors' balance are related to seniors' quality of life and health promotion. Crimmins, Preston, Cohen (2010) drew attention to the influence of social suggestions, that seniors expect an automatic reduction or even loss of their physical balance capabilities, which may negatively affect their abilities and behavior. These authors also stated that fear of certain diseases expected in elderly (e.g. type 2 diabetes mellitus) causes anxiety about loss of balance and the risk of falls. Hahn (2015) declared in the physical balance context, that also psychogenic dizziness may be related to psychic problems such as anxiety, depression, etc. It is reported that psychogenic dizziness occurs in 15% of patients with dizziness who have a normal diagnosis of the physical balance.

Anxiety and worries due to the fact that "I am old", may be an impulse for the physical balance ability decreasing (Vellas, Wayne, Romero, Baumgartner, Garry, 1997; Wang, Goel, Rahemi, Zhang, Lepow, & Najafi, 2019). The stereotype approaches to elderly are based on view that aging is associated with depression, emotional lability, and an overall decline in functional physical, mental and energy potential. An opposite to that the concept of "positive aging" represents, characterized by the fact that seniors are active and curious, take care of their health, do not think of themselves as old people. They are energetic and realize their potential in society (Beskrovnaya, Kovalenko, Chalov, 2016). According to these authors, a social integration in such seniors is in accordance with the energy balance in terms of evaluation of the quality of relation to society and community. Energetically balanced seniors demonstrate social balance in daily life and perceive positively themselves as part of society. Leone (2012) concluded that reasonable diet and balanced social life leads to better overall health feelings in elderly men.

If we leave the traditional balance concept limited to physical biomechanical approach, focus on seniors' balance may represent a relatively interesting psycho-diagnostic problem in relation to their overall physical balance ability and quality of life. Considering the balance in other, global concept of life, balance evaluation leads to an operational holistic definition of physical balance. For example, the mental balance, or rather the balance of ideas, is understood as the quality of thinking, its chronological continuity, causality, calmness, balance sheet, etc. Rather, it will be associated with cognitive processes (IQ) and personal experience. Another interesting category may represent emotional balance, which is rather a symptom of temperament and it represents a subject to examination in a number of scales assessing the current mental states of people and their changes (Hošek, 2019).

Glick (1992) states that although the cut-off point is not clearly defined, age-related changes in energy balance of adults appear to be divided into two non-symmetric phases: the first phase (between 20 and 65 years of age) is typically associated with a positive energy balance and an increase in weight and adiposity, the second phase, beginning after the age of 65 to 70 years, is associated with a loss of weight, mostly accountable for by a loss of lean body mass and with a high prevalence of malnutrition. Tyrovolas, Haro, Mariolis, Piscopo, Valacchi, Makri, et al (2015) declare that high energy intake (i.e., >1,700 kcal/day), as well as positive energy balance, were inversely associated with successful aging.

The social area in the age sixty five and over, i.e. individual incorporation into a tangle of social positions represents another consequence with physical balance ability in seniors sixty five and older. Seniors with frequent social conflicts are considered unbalanced in the social sense of view. Similarly, an extreme loneliness represents a symptom of social imbalance (Tůma, Krejčí, Hošek, (2018). Also Değer, Saraç, Savaş, & Akçiçek (2019) declare that balance disorders have biological and social etiologies, are a major geriatric problem leading to falling and increased morbidity and mortality rates. According this author the preventive health care should be the primary step towards helping today's increasingly elderly population, and the concept of "age-friendly" should be widespread in all segments of the society, including the private sector and public services to improve the social balance in elderly.

Objectives and Hypotheses

The aim of the study is to analyze the predictive components and determinants of overall physical balance, including gait balance in seniors aged sixty five years and older in the context of energy and social balance aspects in seniors aged sixty five years and over.

Hypotheses

H1 In the monitored seniors the level of summary balance score measured by Tinetti Balance Assessment Tool correlates significantly with the level of energy balance measured by the "E" score of the Anamnestic Self-assessment.

H2 In the monitored seniors the level of summary balance score measured by Tinetti Balance Assessment Tool correlates significantly with the level of social balance measured by the "S" score of the Anamnestic Self-assessment.

H3 There are significant predictors influence the summary balance score measured by Tinetti Balance Assessment Tool in the monitored seniors.

Methods

Characteristics of participants, Ethics

In the research study 500 seniors were involved, selected by stratified random sampling from all regions of the Czech Republic, recruited from senior homes and centers on the base of voluntary participation on the basis of signed informed consent. The 500 seniors aged $65 + (age average: 75.9 \, \mathrm{SD} \pm 7.14)$ consisted of 234 men with the age average of 74.5 $\mathrm{SD} \pm 7.74$, median: 71.0 (67.0, 80.0) and 266 women with the age average of 76.9 $\mathrm{SD} \pm 7.23$, median: 76 (66.0, 84.0). The exclusion criteria for involvement of participants in the experiment determined were used according the White Book on Physical and Rehabilitation Medicine in Europe (Gutenbrunner, Ward, & Chamberlein, 2007) as: Human to human infectious diseases and bacillus carrier; All acute-stage diseases and conditions in which destabilization of health state can be reasonably expected; Cachexia of various etiologies; Malignant tumors; Active attacks or phases of psychoses and mental disorders with asocial manifestations or with reduced communication; 2nd and 3rd degree of urinary incontinence and stool incontinence.

The ethics committees of participating institutions expressed the agreement with the research design conformed to requirements stipulated in the Helsinki Declaration. Each senior signed an "Informed Consent" for voluntary participation. Obtaining informed consent from the entire population of 500 elderly volunteers was the cornerstone of the research project because without informed consent, basic research and valid statistical analyses of surveys and evaluation outputs would not be not carried out.

Procedure

The procedure was carried out in the form of the battery of diagnostic methods and statistical analyses. The examinations were carried out under relatively stable conditions: always in the morning, in a spacious bright room equipped with measuring devices. The examinations always started with the "Medical anamnesis" with the help of a protocol in cooperation with a physician. Furthermore, the method "Anamnestic Self-assessment" was applied under guiding of a research team member. Then it was followed by the "Functional anthropological examination" carried out by an anthropologist with 2 assistants. After that the "Tinetti Balance Assessment Tool" test was conducted by a physiotherapist. Afterwards, the senior had a break for 15 minutes, relaxed while sitting and drinking a glass of water. After the break, the Short Form Health Survey (SF-36) was completed with the possible help of a research team member. The data were collected and stored in a prepared database, adequately

protected, in compliance with the rules of personal data protection according to the Regulation of the European Parliament and the Council of the EU 2016/679 (EU, 2016), followed by the "Statistical data processing".

Diagnostics, Statistics description

Medical Anamnesis (Jandová, Formanová, & Morávek, 2018)

The medical anamneses included data concerning basic information and a medical problematic background for use in analyzing of the actual health condition of a senior. The standardized medical anamnesis protocol was applied according the general medical guidelines to assess the health state, drugs consumption, disabilities, operations, etc.

The test "Anamnestic Self-assessment" (Hošek, 2019)

The method was developed in frame of the project GAČR ID 17-25710S "Basic research of balance changes in seniors". Requirements for its application included easy administration, simplicity and comprehensibility for seniors aged sixty five years and over, simple evaluation and interpretation of results from the point of view of use in the research team. The self-assessment graphic scale was chosen as the measuring tool. It allows for small differences in self-assessment to be captured where traditional three-, five-, and seven-point self-assessment scales encounter respondent's assessment stereotypes. Graphic scales avoid frequent controversy when administering classic assessment scales what does it mean, considerably, slightly, etc. Expressing the degree of symptom on a 10 centimeters line circumvents this problem. In addition, it leads to more accurate quantification directly on the ten centimeters' scale. This is a great advantage of graphical self-assessment scales, which has been fully confirmed in senior research. On one sheet of paper, ten items of the "E" scale, i.e. the energy balance, were printed on one side, and the "S" scale, i.e. the balance in the social context, on the other. The instructions to fill in were identical for both scales. The technique of scaling by dividing a ten-centimeter line was understandable for the elderly at the age of sixty-five years and above. For these practical reasons, the items on each scale were ordered alternately so that the maximum of the flag was at the right end of the scale for odd items and at the beginning for the even ones, i.e. at the left end. This prevented the "transparency" of the scale and the resulting stereotypical scaling. The formulations of items did not clearly favor one pole of evaluation in terms of social desirability of the answer were always chosen so that probands with their evaluation can really "balance" over the whole continuum of the scale. After explaining and guaranteeing data intimacy, the proband marks a comma on the line between the counterparts. For the "E" scale, the score above 50 indicates sign of energy expenditure outweighs intake and score below 50 indicates passivity, laziness. For the "S" scale, the score above 50 indicates sign of social disharmony, lower score a non-conflict person.

Functional anthropological examination (Bláha, 2018) Examination consisted of selected classical anthropometry methods, which were non-invasive, using anthropometric instruments as anthropometer, digital personal scale, Harpenden caliper, manual dynamometer type Collin. Following parameters were examined: Body height, body weight, BMI, girth of chest across mesosternale, girth of waist, abdominal circumference, gluteal circumference, arm circumference relaxed, calf circumference maximal, biepicondylar width of humerus, biepicondylar width of femur, width of wrist, width of ankle, girth of thigh, girth of knee, girth of ankle; thickness of 7 selected skinfolds - caliper measurement type Harpenden (biceps, triceps, suprailiac, abdominal, subscapular, anterior thigh, calf medial). Body Composition Analysis using In-Body 230.

"Tinetti Balance Assessment Tool" (Tinnetti, Williasms, & Mayewski, 1986; WHCA, 2013)

The tool represents a valid exam, who evaluates the summary balance score from components: the static balance score and the dynamic balance score. The test assesses balance (static) abilities in a chair and in standing, with maximal score 16, and dynamic balance during gait on a 15 feet even walkway with maximal score 12. Each of the particular aspects of execution of both tasks is assessed with the use of 2 or 3-point scale. Maximal total score is 16 and 12 points for static and dynamic balance, respectively 28 for the summary balance score. The higher the score, the better the performance. The "Tinetti Balance Assessment Tool" has shown good concurrent validity, medium sensitivity and

specificity to a risk of falls and good to excellent inter- and intra-rater reliability (Cipriany-Dacko, Innerst, Johannsen, & Rude, 1997; Kegelmeyer, Kloos, Thomas, Kostyk., 2007).

Tabulka 1./ Table 1.

Q35

Q36

I expect my health to get worse.

My health is excellent.

 $\label{lem:condition} \textit{Dotazník "SF-36"- přehled otázek a kategorií.} \ \textit{The survey "SF-36"- overview of the questions and categories.}$

	all perception of health
Q1	In general, would you say your health is: Excellent; Very good; Good; Fair; Poor?
	Compared to one year ago, how would you rate your general health now? Much better than one
Q2	year ago; Somewhat better than one year ago; About the same; Somewhat worse than one year ago; Much worse than one year ago.
Phys	ical activity
Q3	Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.
Q4	Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf.
25	Lifting or carrying groceries.
26	Climbing several flights of stairs.
27 27	Climbing one flight of stairs.
ي. 28	Bending, kneeling, or stooping.
Q 9	Walking more than a mile.
Q10	Walking several blocks.
Q11	Walking one block.
$\tilde{Q}12$	Bathing or dressing yourself.
_	riction of physical activity
Q13	Cut down the amount of time you spent on work or other activities.
Q14	Accomplished less than you would like.
$\tilde{\mathrm{Q}}15$	Were limited in the kind of work or other activities.
Q16	Had difficulty performing the work or other activities (for example, it took extra effort).
	riction caused by emotional problems
Q17	Cut down the amount of time you spent on work or other activities.
Q18	Accomplished less than you would like.
Q19	Did not do work or other activities as carefully as usual.
Socia	l activity
	During the past 4 weeks, to what extent have your physical health or emotional problems
Q20	interfered with your normal social activities with family, friends, neighbours, or groups?
Pain	
Q21	How much bodily pain have you had during the past 4 weeks?
Q22	During the past 4 weeks, how much did pain interfere with your normal work (including both
	work outside the home and housework)?
Vital	ity, neurosis, depression (Emotional well-being)
Q23	Did you feel full of pep?
Q24	Have you felt like a very nervous person?
Q25	Have you felt so down in the dumps that nothing could cheer you up?
Q26	Have you felt calm and peaceful?
Q27	Did you have a lot of energy?
Q28	Have you felt downhearted and blue?
Q29	Did you feel worn out?
Q30	Have you been a happy person?
Q31	Did you feel tired?
Socia	l activity
Q32	During the past 4 weeks, how much of the time have your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?
Healt	h change
Q33	I seem to get sick a little easier than other people.
Q34	I am as healthy as anybody I know.
005	T

RAND 36 Short Form Health Survey (SF-36) (Ware, Snow, Kosinski, Gandek et al, 1993)

The survey SF-36 represents valid and reliable indicator used globally to determine the quality of life related of overall health status in seniors, designed to research and monitor the quality of senior specific population and of senior general population life as well. In general the questionnaire SF 36 is sensitive to all problems in areas of physical, mental and social health in aging (Brazier, Roberts, & Deverill, 2002; Ware et al., 1993). Responses across the items are scored on scales. It is comprised of 36 items in 9 categories: Overall perception of health; Physical activity, Restriction of physical activity, Restriction caused by emotional problems, Social activity, Pain, Vitality, neurosis, depression (i.e. Emotional well-being), Health change, see Table 1. The score "Emotional well-being" was calculated from items Q23, Q24, Q25, Q26, Q27, Q28, Q29, Q30, Q31 of the SF-36 questionnaire (Ware et al, 1993; Pfoh, Chan, Dinglas, Cuthbertson, Elliott, Porter, Bienvenu, Hopkins & Needham, 2016).

Results

The results are presented gradually from the view of correlation analyses between the Tinetti summary balance score and the results of Anamnestic Self-assessment, anthropometric parameters and psychosocial indices in relation to gender of monitored seniors. Then the summary results of correlation analysis of all monitored seniors on Anamnestic Self-assessment scales "E" and "S", BMI, Fat Mass, Medicaments Consumption and Emotional well-being Score, are presented.

Tabulka 2./ Table 2. Korelační analýza celkového skóre rovnováhy dle Tinetti vs. škály "E" a "S" anamnestického sebeposouzení a položky testu SF-36, hodnoceno modelem O2PLS (N=234 mužů)./ Correlation analyses of the Tinetti summary balance test vs. Anamnestic Self-assessment scales "E" and "S" and test SF-36 items, evaluated by O2PLS model (n=234 males).

		Predicti	ive component	Multiple regression							
	Variable	Component loading t-statistics		R^a		Regression coefficient	t-statistics				
	Self-assessment "E"	0.290	20.57	0.818	**	0.137	21.96	**			
	Self-assessment "S"	0.288	18.95	0.814	**	0.091	3.30	**			
	Q7	0.303	21.34	0.862	**	0.085	5.76	**			
	Q8	0.252	20.99	0.711	**	0.073	2.91	*			
	Q9	0.289	27.16	0.819	**	0.094	5.06	**			
	Q10	0.290	14.06	0.820	**	0.089	2.37	*			
	Q11	0.261	6.64	0.736	**	0.091	3.08	**			
	Q12	0.224	6.85	0.634	**	0.077	3.04	**			
	Q14	0.078	2.00	0.224	*	-0.040	-2.49	*			
	Q15	0.093	2.00	0.265	*	-0.043	-1.78				
Relevant	Q16	0.126	3.90	0.358	**	-0.008	-0.37				
predictors (matrix X)	Q18	0.096	2.81	0.272	*	-0.024	-1.05				
	Q19	0.100	2.47	0.285	*	-0.020	-1.40				
	Q20	-0.102	-4.27	-0.291	**	0,015	0.38				
	Q22	-0.131	-6.25	-0.374	**	0.026	0.97				
	Q27	-0.138	-6.08	-0.386	**	-0.022	-0.88				
	Q29	0.110	3.70	0.308	**	-0.035	-0.89				
	Q30	-0.089	-2.21	-0.250	*	0.011	0.33				
	Q31	0.104	2.28	0.285	*	-0.002	-0.07				
	Q32	0.099	3.35	0.279	**	-0.030	-1.69				
	Q34	-0.121	-5.49	-0.340 **		-0.047	-2.81	*			
	Q36	-0.147	-8.74	-0.413	**	0.009	0.44				
	Age	-0.222	-8.32	-0.613	**	-0.071	-3.30	**			
	Width of Humerus	-0.053	-1.47	-0.135	**	-0.084	-3.82	**			
(matrix Y)	Tinetti Summary balance score	1.000	32.07	0.728	**						
Explained va	ariability	53.1% (46.9	53.1% (46.9% after cross-validation)								

 $[^]a \rm R. \dots Component$ loadings expressed as a correlation coefficients with predictive component, *p < 0.05, **p < 0.01

Results of the male seniors 'parameters interplay

Statistical analysis of the male seniors´ results has shown that significant different results were analyzed in men comparing women in the both scales of Anamnestic Self-assessment. The results show that men are significantly better at energy and social balance than women, that even the analyzed components "E" (energy balance) and "S" (social balance) can be declared as significant predictors positively affecting the summary balance score in male seniors, see Tab. 2 (correlation coefficients with predictive component "E" at p < 0.05 and p < 0.01; correlation coefficients with predictive component "S" at p < 0.01).

The analyzed results of correlations of the monitored group of male seniors examined by the SF-36 resulted in a total of 20 SF-36 items at p < 0.01, p < 0.05. In the monitored seniors there were analyzed as the significant positive predictors for balance ability the items Q7 - Q12 (p < 0.01) which document importance of a good physical functioning for the balance results. Physical activities as for example "Walking up one floor stairs", "Bending, kneeling, or stooping", ability to "Walking more than a mile", "Walking several blocks" or even "Walking one block" and ability for the self-service activities as the "Bathing or dressing yourself" (Tab. 1, Tab. 2). Negative significant correlations with the overall balance level were analyzed in male seniors in relation to subjective feelings "Lack of energy", "Exhaustion", "Missing feelings of happiness" (Tab. 1, Tab. 2). According to the results it can be discussed that social contacts with friends, relatives play a significant role in the overall balance level. Restrictions of social life due to health or emotional problems have a negative impact on the overall balance of the male seniors at p < 0.01. The identical significant negative predictors for monitored male seniors were analyzed in the categories as "Pain", "Vitality, neurosis, depression".

Results of the statistical analyses of the male monitored seniors proved that from the all measured anthropometric parameters only the "Width of humerus" correlates significantly positively with the performance of the Tinetti summary balance test in the investigated male seniors (p < 0.01), see Tab. 2. In the male monitored seniors, it has been found that increasing age is in the negative correlation with the performance of the Tinetti summary balance score (p < 0.01), see Tab. 2.

Results of the female seniors 'parameters interplay

From the provided correlation analyses focused on the interplay of significant correlations between the Tinetti summary balance score and the psychosocial indices it is also evident, that increasing age of female seniors represents the negative predictor of the overall balance ability (p < 0.01), see Tab. 3

Statistical analysis of data obtained on the basis of anamnestic self-assessment of the monitored female seniors showed in both scales that energy and social imbalances negatively correlate with the results of their summary balance ability, expressed by Tinetti summary balance score, see Tab. 3. Statistical analysis of female seniors' results also proved that depressive mood, manifesting themselves by decreasing their ability to experience pleasure, by sadness are clearly a significant negative and risk predictor for the female seniors' overall balance at age sixty five and over, see Tab. 1, Tab. 3.

In the female seniors the statistical analyses of the tool "SF-36" in opposite as in the male seniors, there were found next significant positive predictors: "Overall perception of health", i.e. believing that health is very good, better, then one year ago and further items "Physical activity" category as vigorous activities, moderate activities, lifting or carrying groceries, walking up the stairs in several floors. It seems, that the male seniors suffer less of restriction of physical activity as female seniors (p < 0.01, Tab. 3). In opposite the items Q18, Q19 including in the category "Restrictions caused by emotional problems" were analyzed only in monitored male seniors as significant negative predictors (p < 0.05, Tab. 2). The identical significant negative predictors for both genders of monitored seniors were analyzed in the categories as "Pain", "Vitality, neurosis, depression". The analyzed significant factors as reduce of "Social activity" and "Health change in sense deterioration of health" negatively correlate with overall balance ability in female seniors (Tab. 1, Tab. 3).

Results of the statistical analyses of the anthropometric parameters of female seniors, in a contrast to the male seniors parameters, proved that body high and muscle mass correlate significantly positively with the performance of the Tinetti summary balance test (p < 0.01), see Tab. 3. In the investigated female seniors there were also analyzed as the significant positive predictors the followed anthropometric parameters" the width of ankle, biepicondylar width of femur and the girth of chest, which correlates significantly positively with the Tinetti summary balance test (p < 0.01), see Tab. 3.

Thus, it was found that some optimal female body robustness in dimensions such as chest circumference, biepicondylar width of humerus, biepicondylar width of femur, wrist width, and ankle width correlated positively with summary balance score including gait balance.

Tabulka 3./ Table 3.

Korelační analýza celkového skóre rovnováhy dle Tinetti vs. škály "E" a "S" anamnestického sebeposouzení a položky testu SF-36, hodnoceno modelem O2PLS (N=266 žen)./ Correlation analyses of the Tinetti summary balance test vs. Anamnestic Self-assessment scales "E" and "S" and test SF-36 items, evaluated by O2PLS model (n=266 females).

	Variable elfEval_Energ elfEval_Social Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	Component loading -0.104 -0.078 -0.164 -0.091 0.161 0.247 0.228 0.218 0.238 0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110 0.089	t-statistics -3.66 -5.75 -10.48 -4.63 15.05 17.04 17.98 20.30 24.04 16.74 27.01 24.17 18.94 11.26 2.97 2.30 6.59 5,53	R ^a -0.342 -0.255 -0.540 -0.305 0.534 0.818 0.750 0.718 0.783 0.743 0.835 0.811 0.747 0.725 0.269 0.194 0.464	** ** ** ** ** ** ** ** ** ** ** **	Regression coefficient -0.036 0.011 -0.023 0.096 0.075 0.043 0.059 0.085 0,096 0.078 0.024 0.087 -0.021 -0.062 0.004 0.004	t-statis -1.79 0.38 -1.44 4.20 3.47 6.64 4.80 4.27 5.01 3.59 1.61 3.63 -3.16 -4.56 0.25 0.17	* * * * * * * * * * * * * * * * * * *
Relevant predictors	elfEval_Social Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	-0.078 -0.164 -0.091 0.161 0.247 0.228 0.218 0.238 0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	-5.75 -10.48 -4.63 15.05 17.04 17.98 20.30 24.04 16.74 27.01 24.17 18.94 11.26 2.97 2.30 6.59	-0.255 -0.540 -0.305 0.534 0.818 0.750 0.718 0.783 0.743 0.835 0.811 0.747 0.725 0.269 0.194	** ** ** ** ** ** ** ** ** **	$\begin{array}{c} 0.011 \\ -0.023 \\ 0.096 \\ 0.075 \\ 0.043 \\ 0.059 \\ 0.085 \\ 0.096 \\ 0.078 \\ 0.024 \\ 0.087 \\ -0.021 \\ -0.062 \\ 0.004 \end{array}$	0.38 -1.44 4.20 3.47 6.64 4.80 4.27 5.01 3.59 1.61 3.63 -3.16 -4.56 0.25	* * * * * *
Relevant	Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	-0.164 -0.091 0.161 0.247 0.228 0.218 0.238 0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	$\begin{array}{c} -10.48 \\ -4.63 \\ 15.05 \\ 17.04 \\ 17.98 \\ 20.30 \\ 24.04 \\ 16.74 \\ 27.01 \\ 24.17 \\ 18.94 \\ 11.26 \\ 2.97 \\ 2.30 \\ 6.59 \end{array}$	-0.540 -0.305 0.534 0.818 0.750 0.718 0.783 0.743 0.835 0.811 0.747 0.725 0.269 0.194	** ** ** ** ** ** ** ** ** **	-0.023 0.096 0.075 0.043 0.059 0.085 0,096 0.078 0.024 0.087 -0.021 -0.062 0.004	-1.44 4.20 3.47 6.64 4.80 4.27 5.01 3.59 1.61 3.63 -3.16 -4.56 0.25	* * * * * *
predictors	Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	-0.091 0.161 0.247 0.228 0.218 0.238 0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	-4.63 15.05 17.04 17.98 20.30 24.04 16.74 27.01 24.17 18.94 11.26 2.97 2.30 6.59	-0.305 0.534 0.818 0.750 0.718 0.783 0.743 0.835 0.811 0.747 0.725 0.269 0.194	** ** ** ** ** ** ** ** ** **	$\begin{array}{c} 0.096 \\ 0.075 \\ 0.043 \\ 0.059 \\ 0.085 \\ 0.096 \\ 0.078 \\ 0.024 \\ 0.087 \\ -0.021 \\ -0.062 \\ 0.004 \end{array}$	4.20 3.47 6.64 4.80 4.27 5.01 3.59 1.61 3.63 -3.16 -4.56 0.25	* * * * * *
predictors	Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	0.161 0.247 0.228 0.218 0.238 0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	15.05 17.04 17.98 20.30 24.04 16.74 27.01 24.17 18.94 11.26 2.97 2.30 6.59	0.534 0.818 0.750 0.718 0.783 0.743 0.835 0.811 0.747 0.725 0.269 0.194	** ** ** ** ** ** ** ** ** **	$\begin{array}{c} 0.075 \\ 0.043 \\ 0.059 \\ 0.085 \\ 0.096 \\ 0.078 \\ 0.024 \\ 0.087 \\ -0.021 \\ -0.062 \\ 0.004 \end{array}$	3.47 6.64 4.80 4.27 5.01 3.59 1.61 3.63 -3.16 -4.56 0.25	* * * * * *
predictors	Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	0.247 0.228 0.218 0.238 0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	17.04 17.98 20.30 24.04 16.74 27.01 24.17 18.94 11.26 2.97 2.30 6.59	0.818 0.750 0.718 0.783 0.743 0.835 0.811 0.747 0.725 0.269 0.194	** ** ** ** ** ** ** ** **	$\begin{array}{c} 0.043 \\ 0.059 \\ 0.085 \\ 0.096 \\ 0.078 \\ 0.024 \\ 0.087 \\ -0.021 \\ -0.062 \\ 0.004 \end{array}$	6.64 4.80 4.27 5.01 3.59 1.61 3.63 -3.16 -4.56 0.25	* * * * *
predictors	Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	0.228 0.218 0.238 0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	17.98 20.30 24.04 16.74 27.01 24.17 18.94 11.26 2.97 2.30 6.59	0.750 0.718 0.783 0.743 0.835 0.811 0.747 0.725 0.269 0.194	** ** ** ** ** ** ** ** **	$\begin{array}{c} 0.059 \\ 0.085 \\ 0.096 \\ 0.078 \\ 0.024 \\ 0.087 \\ -0.021 \\ -0.062 \\ 0.004 \end{array}$	4.80 4.27 5.01 3.59 1.61 3.63 -3.16 -4.56 0.25	* * * *
predictors	Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	0.218 0.238 0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	20.30 24.04 16.74 27.01 24.17 18.94 11.26 2.97 2.30 6.59	0.718 0.783 0.743 0.835 0.811 0.747 0.725 0.269 0.194	** ** ** ** ** ** ** **	$\begin{array}{c} 0.085 \\ 0.096 \\ 0.078 \\ 0.024 \\ 0.087 \\ -0.021 \\ -0.062 \\ 0.004 \end{array}$	4.27 5.01 3.59 1.61 3.63 -3.16 -4.56 0.25	* * *
predictors	Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	0.238 0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	24.04 16.74 27.01 24.17 18.94 11.26 2.97 2.30 6.59	0.783 0.743 0.835 0.811 0.747 0.725 0.269 0.194	** ** ** ** ** **	0,096 0.078 0.024 0.087 -0.021 -0.062 0.004	5.01 3.59 1.61 3.63 -3.16 -4.56 0.25	* * *
predictors	Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	0.225 0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	16.74 27.01 24.17 18.94 11.26 2.97 2.30 6.59	0.743 0.835 0.811 0.747 0.725 0.269 0.194	** ** ** ** **	0.078 0.024 0.087 -0.021 -0.062 0.004	3.59 1.61 3.63 -3.16 -4.56 0.25	*
predictors	Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	0.255 0.245 0.226 0.218 0.080 0.057 0.139 0.110	27.01 24.17 18.94 11.26 2.97 2.30 6.59	0.835 0.811 0.747 0.725 0.269 0.194	** ** ** **	0.024 0.087 -0.021 -0.062 0.004	1.61 3.63 -3.16 -4.56 0.25	*
predictors	Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17	0.245 0.226 0.218 0.080 0.057 0.139 0.110	24.17 18.94 11.26 2.97 2.30 6.59	0.811 0.747 0.725 0.269 0.194	** ** **	0.087 -0.021 -0.062 0.004	3.63 -3.16 -4.56 0.25	*
predictors	Q11 Q12 Q13 Q14 Q15 Q16 Q17	0.226 0.218 0.080 0.057 0.139 0.110	18.94 11.26 2.97 2.30 6.59	0.747 0.725 0.269 0.194	** ** *	-0.021 -0.062 0.004	-3.16 -4.56 0.25	*
predictors	Q12 Q13 Q14 Q15 Q16 Q17	0.218 0.080 0.057 0.139 0.110	11.26 2.97 2.30 6.59	0.725 0.269 0.194	**	-0.062 0.004	$-4.56 \\ 0.25$	
predictors	Q13 Q14 Q15 Q16 Q17	0.080 0.057 0.139 0.110	2.97 2.30 6.59	$0.269 \\ 0.194$	*	0.004	0.25	*
predictors	Q14 Q15 Q16 Q17	0.057 0.139 0.110	$2.30 \\ 6.59$	0.194				
predictors	Q15 Q16 Q17	$0.139 \\ 0.110$	6.59		*	0.004	0.17	
predictors	Q16 Q17	0.110		0.464		0.004	~ •	
predictors	Q17		5.53		**	-0.021	-1.02	
predictors		0.090	-,	0.370	**	-0.052	-2.80	
		0.069	3.63	0.292	**	0.025	1.71	
matrix X)	Q20	-0.134	-7.33	-0.449	**	0.048	5.66	>
	Q21	-0.072	-5.31	-0.244	**	0.048	4.08	>
	Q22	-0.120	-8.48	-0.404	**	-0.020	-1.48	
	Q23	-0.176	-13.23	-0.578	**	-0.014	-0.59	
	Q25	0.078	2.71	0.260	*	-0.007	-0.39	
	Q26	-0.120	-8.17	-0.399	**	-0.025	-1.92	
	Q27	-0.169	-8.37	-0.556	**	-0.004	-0.16	
	Q28	0.098	3.09	0.322	**	0.010	0.55	
	Q29	0.103	4.48	0.339	**	-0.010	-0.65	
	Q30	-0.125	-6.06	-0.410	**	-0.028	-2.45	
	Q31	0.115	6.56	0.387	**	0.017	0.99	
	Q32	0.133	4.20	0.444	**	0.036	1.85	
	Q33	0.114	8.49	0.372	**	-0.015	-0.63	
	Q34	-0,125	-6.31	-0.412	**	0.044	3.28	*
	Q35	0.112	11.65	0.367	**	-0.008	-0.65	
	Q36	-0.154	-13.97	-0.503	**	-0.068	-6.34	*
	Age	-0.187	-12.38	-0.618	**	0.004	0.22	
	Body height	0.093	4.00	0.307	**	0.037	1.26	
	Body mass	0.019	1.30	0.064	*	0.110	7.82	k
W	Vidth of ankle	0.099	6.41	0.284	**	0.028	2.67	
	idth of femur	0,165	8.26	0.471	**	0.043	2.10	
	Girth of chest	0,082	3.62	0.263	**	0.045	1.60	
	netti Summary	1.000	33.50	0.717	**			

 $[^]a$ R...Component loadings expressed as a correlation coefficients with predictive component, *p < 0.05, **p < 0.01

The above results verify the established hypothesis "The verification of the hypothesis results from the analyzed significantly correlation dependencies of the monitored physical, energy and social components with respect to the performance in the summary balance test according to the "Tinetti Balance Assessment Tool", as well as the age and sex of monitored persons aged sixty five and over.

Results of the correlation analysis of seniors in relation to social balance

Summary results of correlation analysis of all monitored men and women together on Anamnestic Self-assessment scales "E" and "S" and BMI, Fat Mass, Medicaments Consumption and Emotional well-being score proved that the use of analgesics has a significant negative impact on both social balance and the emotional well-being score (Tab. 4).

Tabulka 4./ Table 4.

Korelační analýza škál "E" a "S" anamnestického sebeposouzení, BMI, tukové hmoty, konzumace léků a skóre emočního zdraví hodnoceno modelem O2PLS ($n=500,\ 234\ males,\ 266\ females$). Correlation analyses of Anamnestic Self-assessment scales "E" and "S", BMI, Fat Mass, medicaments consumption and emotional well-being score of monitored seniors, evaluated by O2PLS model ($n=500,\ 234$ males, $266\ females$).

		Predictiv y vs. x	e compone	ent		Multiple regression Self-assessment "S"			Multiple regression S – deviation of norm			Multiple regression Emotional well-being score		
	Variable	Component loading	t-statistics	\mathbb{R}^a		Regression coefficient		t-statistics	Regression coefficient		t-statistics	Regression coefficient		t-statistics
	Analgetics	0.218	4.07	0.351	**	-0.063	-4.26	**	0.071	7.70	**	-0.091	-1.43	*
tors	Psychopharmaceuticals	0.443	6,78	0.713	**	-0.122	-3.13	**	0.083	1.41		0.220	1.95	**
X)	BMI	0.382	5,82	0.616	**	-0.102	-2.67	*	0.108	2.25	*	-0.098	-1.73	
Relevant predictors (matrix X)	Self-assessment "E"	0.504	12,50	0.811	**	-0.167	-6.45	**	0.169	5.53	**	-0.103	-0.81	*
	E – deviation of norm	0.514	8,24	0.827	**	-0.183	-5.55	**	0.179	5.26	**	-0.063	-0.90	
Rel	Fat mass	0.347	3,01	0.559	**	-0.072	-2.18	*	0.092	1.92	*	-0.186	-3.40	**
	Self-assessment "S"	-0.646	-6.68	-0.488	**									
(matrix Y)	S – deviation of norm	0.659	3.94	0,497	**									
(mat)	Emotional well-being score	-0.431	-2.40	-0.175	*									
Explained variability		16.9% (15% after cross-validation)				23.8 % (22.3% after a cross-validation)			24.7 % (22.2% after a cross-validation)			11 % (4.5% after a cross-validation)		

^aR...Component loadings expressed as a correlation coefficients with predictive component, *p<0.05, **p<0.01

On the basis of this analysis it was further proven that the use of psych pharmaceuticals also has a significantly negative impact on social balance in both sexes. Also, high BMI and body fat percentage negatively correlate with social balance, see Tab. 4. Significant deviations from the energy balance, i.e. the energy imbalance, significantly negatively correlates with the social balance in both sexes of monitored seniors aged sixty five and over.

Based on the presented significant findings the hypothesis H1: "In the monitored seniors the level of summary balance score measured by "Tinetti Balance Assessment Tool" correlates significantly with the level of energy balance measured by the "E" score of the Anamnestic Self-assessment" was verified. The hypothesis H2: "In the monitored seniors the level of summary balance score measured by "Tinetti Balance Assessment Tool" correlates significantly with the level of social balance measured by the "S" score of the Anamnestic Self-assessment" was verified. The hypothesis H3: "There are significant predictors influence the summary balance score measured by "Tinetti Balance Assessment Tool" in the monitored seniors" was also verified.

Discussion

The results proved, that the negative predictor for the Tinetti summary balance score represents the increasing age of the seniors sixty five years and over. The increasing age is an important negative predictor of balance performance in male and female seniors. This finding is consistent with the research results of Balogun, Akindele, Nihinlola, Marzouk (1994) and Avendano, Glymour, Banks, Mackenbach, (2009), that balance performance for both genders increased with chronological age, peaked in the age 30-40 years old and after a progressive decline was found. So, it would be fruitful to start with balance development preventively since from the fourth decade of life. Of course, it is good to start with balance exercises in any age, but it seems that a crucial period is in the fourth decade. With increasing age, decreasing muscle mass and muscle strength tend to diminish, which, as shown above, may play a key role in the level of performance in the Tinetti summary balance test of female seniors. According to Lehnert, Sudeck, Conzelmann (2012), McArdle, Katch, F., Katch, V. (2007) and Lockenhoff, Carstensen, (2004), it is very important to discuss the individual possibility of seniors motivating to provide daily adequate physical activity sequences according to the individual capacity and specifics. The analyzed factors are significant for an overall mobility and walking fitness. From the discussed facts we can summarize, that the optimal and necessary prevention of problems with balance in senior age is exercising and walking, which needs to be developed in various ways, possibly using walking aids (walking sticks, walkers for seniors, etc.). Adequate controlled physical activity also helps to maintain mobility and prevent psychosomatic problems associated with sedentary behavior and a hypokinetic lifestyle (Rehor, Kornatovská, 2013; Oxley, 2009). Lack of physical activities also has a detrimental effect on the psyche of seniors in the form of irritability, reduced self-control and reduced ability to concentrate (Kornatovská, 2014; Krejčí, Hošek et al., 2016).

In the context it is also important to manage walking up the stairs as another analyzed significant positive predictor for the performance in the Tinetti summary balance test of male seniors. Another important factor for managing the overall balance in male seniors aged 65+ is to keep and develop the body flexibility, namely the ability of Bending, kneeling, or stooping.

In the male seniors only the width of humerus correlated significantly as positive predictor of the Tinetti summary balance test (p < 0.01), see Table 2. It can be discussed in accordance with Bláha (2018) and Oatis (2016) that an optimal robustness of female body can be presented as predictor with significant positive influence for overall balance ability in the age 65+ and over. Frost (2013) states that the biepicondylar width of the femur itself already provides information about the robustness of the skeleton, and it is valid for both genders males and females as the significant positive predictor of the overall balance in seniors. It may play a positive role in injuries and falls prevention.

Programs for the balance development in senior age may represent a topical research focus. Every senior wishes to return to the original balanced state. The development of the elderly towards social balance is closely linked to the energetic and the physical balance. Social balance can be thus characterized as an increase in balance manifested in both individual action, e.g. walking and social interaction.

Conclusion

The aim of the presented research study was fulfilled. There were analyzed the predictors interplaying significantly with the performance of Tinetti summary balance test, i.e. predictors significantly positively influent the level of the Tinetti summary balance test as physical fitness and ability for the self-service, for subjective happiness, social self-confidence and i.e. the predictors influent significantly negatively the level of the Tinetti summary balance test as: Increasing age, Health decreasing expectation; Social isolation. In the female seniors significant positive predictors for the balance performance, including walking, are: an optimal "Robustness of the skeleton"; "Muscle mass; "Muscle power"; Social balance.

In the study, two another considered areas of balance, which have a close relation to the seniors´ quality of life, were selected for analyze, i.e. "Energy balance" and "Social balance". The energy uptake and expenditure represents an important vital aspect related to the level of seniors´ physical activity and the prosperity of their motor functions. We do not mean a physiological approach of calorimetric nature, precisely evaluating energy food inputs and corresponding human energy expenditure. In our broader concept we consider the senior's approach to food and muscle effort as the basic attributes of

energy input and output in the age of sixty five and over. Social balance is related to the internally felt experience of social experience and to the objectively shaped social balance in the given social environment. Any negative change in the social environment of seniors correlates negatively with energy and physical balance aspects. Thus negative changes in physical balance can lead to a reduction in physical activity and the quality of life decreasing.

We are aware of the limits of our research. Despite all our efforts to follow the basic research methodology, it should be noted that the sample examined cannot fully reflect the general population of seniors aged 65 years and older. Another limitation is the lack of previous research studies on this topic, especially in the Czech environment that could be relied upon. We recommend further research to review the results.¹

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