SHORT REPORT

Gait ability analyse in senior age 65+ related to the quality of life indicators

MILADA KREJČÍ[1], MARTIN HILL[2], DOBROSLAVA JANDOVÁ[1], MIROSŁAW PAWEŁ GÓRNY[1], JIŘÍ KAJZAR[1]

Corresponding author: krejci@palestra.cz

[1] College of Physical Education and Sport PALESTRA, Prague, Czech Republic
[2] Institution of Endocrinology, Prague, Czech Republic

Abstract

Introduction. In the study the gait indicators measured by the Tinetti Gait Test are analysed in correlation to indicators of the quality of life of seniors according to the RAND 36 Short Form Health Survey (SF-36). **Aim of Study.** Main aim of the presented study is to point out the gait ability of seniors aged sixty-five and older in the complexity analysis of bio-psycho-social approach. **Material and Methods.** The research sample for the study consisted of 500 seniors of the Czech Republic, selected by randomized selection from all Czech regions, from seniors' houses. The monitored seniors were in age 65 years and older (mean: 75.9 SD ± 7.14), 234 males (mean: 74.5 SD ± 7.74) and 266 females (mean: 76.9 SD ± 7.23). The seniors participated in the investigation voluntarily on the base of signed informed consent. Diagnostic methods: medical anamnesis; functional anthropological examination; Tinetti Gait Test; RAND 36 Short Form Health Survey (SF-36). Statistics: multivariate regression with reduction of dimensionality, method of orthogonal projection to latent structure. **Results.** The created linear regression model was highly statistically significant (p < 0.001) and showed high selectivity as well as high specificity to the SF-36 items. The clinical validity of the model demonstrated a 72% predictive value for the detection and an 87% successful specification of the items of health survey SF-36 in correlation to the Tinetti Gait Test. Also higher age of seniors, number of taken medicaments, health problems as diabetes, sclerosis multiplex, haemorrhage, heart problem and stroke are in significant negative correlation to the Tinetti Gait Test result. **Conclusions.** The study demonstrated the possibility of the gait ability in seniors 65+ may be searched very closely and significantly related to the physical, psychic and social quality of life indicators. The analysed predictors to the successful gait ability development are inspiration for experts, which focus their work on kinesiotherapy and adapted physical education in senior age.

KEYWORDS: ageing, balance, gait disorders, health support, quality of life.

Introduction

Gait ability represents a complex of motor skills learned due motor learning in the first three years of human life. In adult age gait is performed automatically by persons without any disorders. But in senior age sixty five years old and over, gait starts be not performed automatically. Seniors need more control and more attention for walking and gait. Unfortunately, falls are an accompanying phenomenon of gait in seniors aged sixty-five and older. Gait impairments are one of the biggest risk factors in ageing [11].

The central nervous system controls spinal reflexes and muscle activity leading to an upright posture while gait, walking. Synchronous postural muscles and feedback processing to maintain the physical balance needed for coordinated gait can be disrupted by psychological or social imbalances or a combination of them. This is a prerequisite for the scientific question of how indicators of quality of life in aging are related to gait ability in senior age. A major role in psychological and social imbalances plays a subjective experience of everyday situations, but also a subjective experience of movement

and space orientation [3]. The population of European Union is becoming older, number of people aged sixty five years and older is increasing. In the area of actual research in the field of adapted physical activities and physical education in elderly, the contributions related to senior gait ability and gait skills are very actual from the view of a broad bio-psycho-social aspects of kinesis protection in aging, including an economic impact on injury prevention on foundations of physical balance development in senior age above sixty five years old [6, 7, 11].

Health literacy of seniors should be in close relation to their movement literacy as an important part of injury prevention [1]. According the study [9] the current population due to age distribution requires more and more examination and treatment of dizziness and associated problems of balance ability and risk of falls during gait. Psychogenic dizziness – vertigo can be assigned to psychiatric disorders (e.g. anxiety, depression). Dizziness is a common disorder of older age categories.

Authors of study [5] present that gait disorders are common both with aging and in the setting of specific neurological disorders and are a risk factor for dependence, cognitive decline, falls and death. After age 70 years, 35% of people have abnormal gait; after the age 85 years gait changes are found in the majority of people. Additionally includes weakness, exhaustion, decreased activity, and slowed walking. Loss of muscle mass is also seen with motor neuron loss may occur with progressive pathological loss found in amyotrophic lateral sclerosis, wherein gait change include contributions from both weakness and pyramidal system involvement. In older people changes may be significant enough to justify a specific diagnosis but may occur at a sub-clinical level as well [5].

The objective of the article is to develop understanding of the bio-psycho-social consequences of the gait phenomena in senior age and to provide quantitative and qualitative research analyses concerning the gait control and management in holistic epistemological concept, when physical imbalances have an impact on emotional imbalances in ageing, being also reflected in social imbalances.

Aim of Study

The aim of the presented study is to point out the gait ability of seniors aged sixty-five and older in the complexity analysis of bio-psycho-social approach. Based on the defined aim, two hypotheses were given.

Hypotheses:

H1 Minimally 12 selected quality of life items examined by SF-36 will be in significant correlation with results of the Tinetti Gait Test, in sample of investigated seniors.

H2 Muscle mass will be in the significant positive correlation with results of the Tinetti Gait Test, in sample of investigated seniors.

Material and Methods

The research material for the study consisted of 500 seniors of the Czech Republic, selected by randomized selection from all Czech regions, from seniors' houses. The monitored seniors were in age 65 years and older (mean: 75.9 SD ± 7.14), 234 males – mean: 74.5 SD ± 7.74, median: 71.0 (67.0, 80.0) and 266 females – mean: 76.9 SD ± 7.23, median: 76. (66.0, 84.0). The seniors participated in the investigation voluntarily on the base of signed informed consent.

Followed diagnostic methods were used in the investigation.

Medical anamnesis. The background of a person accumulated data concerning basic information and a medical problematic background for use in analysing of the actual health condition of senior age.

Functional anthropological examination. It was created of selected classical anthropometry methods, which were non-invasive, using anthropometric instruments as anthropometer, digital personal scale, Harpenden calliper, 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 – calliper measurement type Harpenden (biceps, triceps, suprailiac, abdominal, subscapular, anterior thigh, calf medial). Body Composition Analysis using InBody 230. The methods in the functional anthropological examination were provided according methodological description of the followed author [4].

Tinetti Gait Test. The gait ability was quantified using the Tinetti Gait Test in the form of gait scale score. During the Tinetti Gait Test senior stands with investigator, walks across room (+/− aids), first at usual pace, then at rapid pace [15].

RAND 36 Short Form Health Survey (SF-36). The survey SF-36 represents widely used tool to determine the quality of life related to health 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. It consisted of 36 questions grouped into 9 categories (Table 2). The SF-36 is a tool managed by a non-profit organization RAND Corporation [16, 17].

Statistics. For the statistic evaluation were chosen multivariate regression with reduction of dimensionality such as the method of orthogonal projection to latent structure (OPLS) which are capable to cope with the problem of multicollinearity, which is expectable namely in the anthropometric data [2, 14]. Statgraphic Centurion software, version XVI from Statpoint Inc., Warrenton, Virginia, was used for statistical evaluation.

Results

No significant inter-sexual differences were found in all studied variables. From the analysed results focused on correlations between indicators of quality of life examined by SF-36 with results of the Tinetti Gait Test, it is evident that 33 questions, i.e. 91.7%, of all 36 questions (indicators of senior quality of life) are significant to the Tinetti Gait Test in correlation coefficients with $*p < 0.05$, $**p < 0.01$ (Table 1). Comparing the relationships between analysed gait ability examined by the Tinetti Gait Test and indicators of quality of life examined by

Table 1. Relationships between analysed gait ability examined by the Tinetti Gait Test and indicators of quality of life examined by SF-36, evaluated by OPLS model (n = 500; 234 males, 266 females)

		Predictive component, OPLS					
	Variable	Component loading	95% confidence interval	99% confidence interval	Component weight/95%IS	Component weight/99%IS	
matrix X	Question 1	−0.169	0.034	0.053	−5.03	−3.18	**
	Question 2	−0.102	0.027	0.043	−3.77	−2.38	**
	Question 3	0.145	0.025	0.040	5.79	3.66	**
	Question 4	0.252	0.029	0.045	8.80	5.56	**
	Question 5	0.236	0.030	0.047	7.98	5.04	**
	Question 6	0.229	0.022	0.035	10.44	6.60	**
	Question 7	0.234	0.014	0.023	16.25	10.27	**
	Question 8	0.234	0.019	0.030	12.22	7.72	**
	Question 9	0.247	0.018	0.029	13.35	8.44	**
	Question 10	0.247	0.020	0.031	12.61	7.97	**
	Question 11	0.226	0.034	0.054	6.65	4.20	**
	Question 12	0.221	0.025	0.040	8.66	5.48	**
	Question 13	0.077	0.042	0.067	1.83	1.15	**
	Question 14	0.057	0.021	0.033	2.72	1.72	**
	Question 15	0.106	0.027	0.042	3.99	2.52	**
	Question 16	0.100	0.021	0.034	4.69	2.97	**
	Question 17	0.062	0.029	0.046	2.15	1.36	**
	Question 20	−0.125	0.058	0.092	−2.16	−1.36	**
	Question 21	−0.082	0.054	0.086	−1.52	−0.96	*
	Question 22	−0.127	0.050	0.079	−2.53	−1.60	**
	Question 23	−0.163	0.047	0.074	−3.46	−2.19	**
	Question 25	0.073	0.026	0.041	2.84	1.80	**
	Question 26	−0.119	0.049	0.077	−2.43	−1.54	**
	Question 27	−0.163	0.043	0.068	−3.82	−2.42	**

	Question 28	0.074	0.041	0.065	1.80	1.13	**
	Question 29	0.096	0.036	0.057	2.65	1.68	**
	Question 30	−0.126	0.051	0.081	−2.45	−1.55	**
	Question 31	0.089	0.037	0.059	2.38	1.51	**
	Question 32	0.115	0.037	0.059	3.11	1.97	**
	Question 33	0.094	0.034	0.054	2.76	1.74	**
	Question 34	−0.125	0.049	0.078	−2.55	−1.61	**
	Question 35	0.104	0.046	0.072	2.27	1.44	**
	Question 36	−0.158	0.055	0.087	−2.86	−1.81	**
matrix Y	Tinetti Gait Test	1.000	0.048	0.076	20.80	13.14	**
Explained variability		42.6% (35.8% after cross-validation)					
Component loadings expressed as a correlation coefficients with predictive component, *p < 0.05, **p < 0.01.							

SF-36, evaluated by OPLS model, with the overview of questions of SF-36, divided into 9 categories, we can identify positive, supportive factors and predictors for the gait of investigated seniors (Table 1, Table 2, Figure 1).

The positive correlation on the level p < 0.01 is between the performance of Tinetti Gait Test and the category "Physical activity" consisted from the questions 3-12. It means that senior, who has good physical skills, like

Table 2. Overview of questions of the RAND 36 Short Form Health Survey (SF-36), divided into 9 categories

Overall percept ion of health

1. In general, would you say your health is: Excellent; Very good; Good; Fair; Poor.
2. Compared to one year ago, how would you rate your health in general now? Much better now than one year ago; Somewhat better now than one year ago; About the same; Somewhat worse now than one year ago; Much worse now than one year ago.

Physical activity

3. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.

4. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf.

5. Lifting or carrying groceries.

6. Climbing several flights of stairs.

7. Climbing one flight of stairs.

8. Bending, kneeling, or stooping.

9. Walking more than a mile.

10. Walking several blocks.

11. Walking one block.

12. Bathing or dressing yourself.

Restriction of physical activity

13. Cut down the amount of time you spent on work or other activities.

14. Accomplished less than you would like.

15. Were limited in the kind of work or other activities.

16. Had difficulty performing the work or other activities (for example, it took extra effort).

Restrictions caused by emotional problems
17. Cut down the amount of time you spent on work or other activities.
18. Accomplished less than you would like.
19. Didn't do work or other activities as carefully as usual.

Social activity
20. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

Pain
21. How much bodily pain have you had during the past 4 weeks?
22. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

Vitality, neurosis, depression
23. Did you feel full of pep?
24. Have you been a very nervous person?
25. Have you felt so down in the dumps that nothing could cheer you up?
26. Have you felt calm and peaceful?
27. Did you have a lot of energy?
28. Have you felt downhearted and blue?
29. Did you feel worn out?
30. Have you been a happy person?
31. Did you feel tired?

Social activity
32. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

Health change
33. I seem to get sick a little easier than other people.
34. I am as healthy as anybody I know.
35. I expect my health to get worse.
36. My health is excellent.

for example: vigorous activities, such as running, lifting heavy objects; moderate activities, such as moving a table, pushing a vacuum cleaner, bowling; lifting or carrying groceries; climbing one or several flights of stairs; is able to provide bending, kneeling, or stooping; walking more than a mile; bathing or dressing yourself (Table 2), has very good performance in Tinetti Gait Test. Positive predictor is if senior has no restriction of physical activity (questions 13-16 Table 2, Figure 1) and in part no restriction caused by emotional problems (question 17). With the questions 18 and 19 was not analysed a significant correlation with Tinetti Gait Test results in monitored seniors. It can be declared that items:

"Accomplished less than you would like" and "Didn't do work or other activities as carefully as usual" do not have a significant effect on the quality of the gait. Also in the question 24 ("Have you been a very nervous person?") was not found a significant correlation with the Tinneti Gait Test result. Vitality and believe in own strong health are predictors for good gait ability (Table 1, Table 2, Figure 1). The mentioned results of the statistical analysis confirm the validity of the Hypothesis H1, that "Minimally 12 selected quality of life items examined by SF-36 will be in significant correlation with results of the Tinetti Gait Test, in sample of investigated seniors". Statistical analysis confirm also high reliability of the
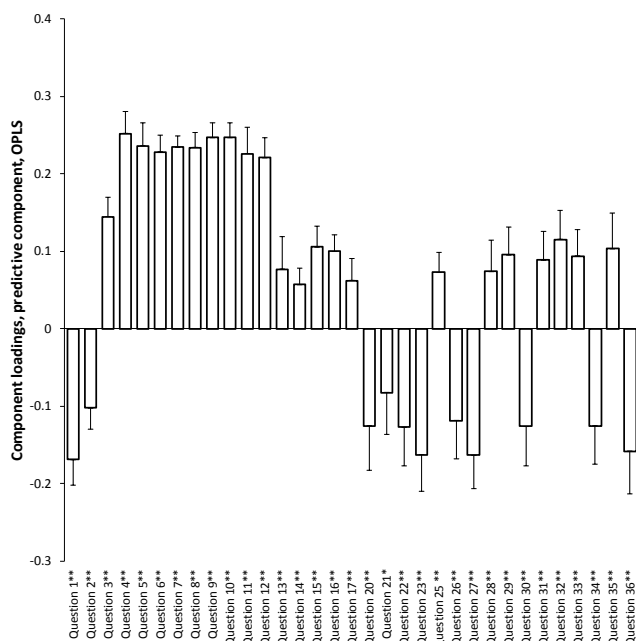
Figure 1. Indicators of quality of life examined by SF-36 with positive or negative correlation to the Tinetti Gait Test, evaluated by OPLS model (n = 500; 234 males, 266 females) expressed correlation coefficients with *p < 0.05, **p < 0.01

health survey (SF-36) to the investigated population of elderly aged sixty five years old and over.

Significantly negatively correlated with Tinetti Gait Test the category "Overall perception of Health" (questions 1, 2), when "fair and poor perception of health" and "much worse perception of health than one year ago" influence negatively on gait ability with significance (p < 0.01). Also the negative correlation was analysed in the Tinetti Gait Test with situations, when during the past 4 weeks of seniors' life, physical health problems or emotional problems interfered with normal social activities with family, friends, neighbours, or groups (question 20, category "Social activity"). The problems with reduction of normal social activities are in context with the low level of confidence and self-assurance of seniors in the category "Health change", esp. disbelief in own good health (questions 34, 36). Statistically it was analysed in questions 21, 22 a negative impact on gait ability when seniors felt pain (Table 1, Table 2, Figure 1).

Results presented in Table 3, Figure 2 selected through statistical analysis of data, evaluated by OPLS model, positive or negative indicators of medical anamnesis

Table 3. Relationships between analysed Gait ability examined by the Tinetti Gait Test and selected indicators of Medical anamnesis and Functional anthropological examination, evaluated by OPLS model (n = 500; 234 males, 266 females)

		Predictive component, OPLS					
	Variable	Component loading	95% confidence interval	99% confidence interval	Component weight/95%IS	Component weight/99%IS	
matrix X	Diabetes	−0.123	0.025	0.039	−4.94	−3.12	**
	Sclerosis multiplex	−0.049	0.049	0.078	−1.01	−0.64	*
	Heart problem	−0.099	0.066	0.105	−1.50	−0.95	*
	Stroke	−0.081	0.050	0.079	−1.61	−1.02	**
	Haemorrhage	−0.069	0.040	0.063	−1.72	−1.08	**
	Medication	−0.129	0.045	0.072	−2.86	−1.81	**
	Age	−0.143	0.030	0.048	−4.74	−3.00	**
	Biepicondylar width of femur	0.148	0.043	0.068	3.47	2.19	**
	Girth of chest	0.061	0.048	0.076	1.26	0.80	*
	Girth of thigh	−0.047	0.023	0.037	−2.02	−1.28	**
	Girth of knee	0.061	0.053	0.084	1.15	0.73	*
	Girth of wrist	0.047	0.035	0.055	1.35	0.85	*
matrix Y	Tinetti Gait Test	1.000	0.048	0.076	20.80	13.14	**
Explained variability		42.6% (35.8% after cross-validation)					

Component loadings expressed as a correlation coefficients with predictive component, *p < 0.05, **p < 0.01.
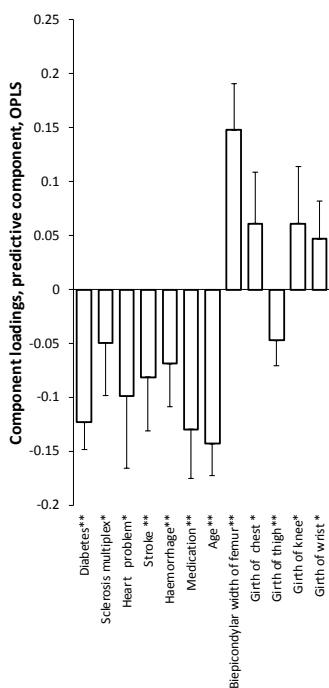
Figure 2. Selected indicators of medical anamnesis and functional anthropological examination with positive or negative correlation to the Tinetti Gait Test, evaluated by OPLS model (n = 500; 234 males, 266 females) expressed correlation coefficients with *p < 0.05, **p < 0.01

and functional anthropological examination on the Tinetti Gait Test result. Significantly negatively affected on the gait ability the found predictors of medical anamnesis analyse, i.e. age, medicaments, and diseases as diabetes, sclerosis multiplex, heart problem, stroke and haemorrhage. Some of consumed medicaments can influence physical or mental balance and consequently can have a negative impact on gait ability.

From the functional anthropological examination it was found out only one item with the negative correlation to the Tinetti Gait Test result in the monitored seniors, i.e. girth of thigh. Probably strong thighs are associated with frequent knee valgus problem, which reduce quality and ability of gait. In the sense of the established hypothesis H2 "Muscle mass will be in the significant positive correlation with results of the Tinetti Gait Test, in sample of investigated seniors" we expected of data analyses that the muscle mass will be evaluated as significant positive anthropological predictor for Tinneti Gait Test. On the base of the provided statistical analyses we must state that the H2 hypothesis has not been verified (Table 3, Figure 2).

Provided statistical analysis showed that significant positive impact on performance in Tinetti Gait Test had

analysed anthropometric indicators as: biepicondylar width of femur (p < 0.01), girth of chest, girth of knee and girth of wrist (p < 0.05) (Table 3, Figure 2). All found anthropometric predictors for good performance in gait test, i.e. biepicondylar width of femur, girth of chest and girth of knee and girth of wrist provide information on the robustness of the skeleton as is referred by [4].

Discussion

Application of statistical analysis of multivariate regression with reduction of dimensionality has been chosen well in their ability to linearly reduce the dimensionality of a given multivariate data set. The effective number of major components made possible maximum amount of size reduction without destroying of the valid information. This fact are in relation with the hypotheses verification [2].

The hypotheses H1 "Minimally 12 selected quality of life items examined by SF-36 will be in significant correlation with results of the Tinetti Gait Test, in sample of investigated seniors" was verified. On the base of the analysed findings we can discuss that emotional state and reduce of social activity are negative important predictors of the gait ability in senior age sixty five and over, fully in line with the results of the studies of authors [13]. On the other hand, physical activity and physical skills are significant positive predictors to ability of gait performance. Also no restrictions caused by physical or emotional problems significantly positively influence gait ability as it is consistent with the published findings of studies of authors [10, 13].

The hypotheses H2 "Muscle mass will be in the significant positive correlation with results of the Tinetti Gait Test, in sample of investigated seniors" was not verified. It was found that higher age significantly negatively correlates with ability of Tinetti Gait Test. It can be therefore, that in higher age the muscle mass is reduced [9]. Findings of the medical anamnesis have shown that diseases such as diabetes, sclerosis multiplex, haemorrhage, heart problem and stroke are in significant negative correlation to the Tinetti Gait Test result. Very important is, according [10, 12] to discuss the individual possibility to motivation of senior to master the ability slow provided adequate movement sequences according breathing capacity, and to relax and unblock physical, mental and social tensions. It seems to be very beneficial to the gait ability in senior age sixty five and over. The authors [8] expressed in their study that physical fitness is determined by numerous genes, and its genetic determinants are modified by environmental factors. Currently it contains more than 200 genes associated with

such aspects as respiratory and cardiovascular stability; body build and composition – especially muscle mass and strength; carbohydrate and lipid metabolism; response to training; and exercise intolerance. Also findings of experts [5], that cardiorespiratory and musculoskeletal changes contribute to age-related changes in gait.

Important aspects of the research derived from our study is discussed in line with [4], when positive influence of a robustness of the body character on the base of selected significant indicators as biepicondylar width of femur, girth of chest, girth of knee and girth of wrist, represent marker of active life style in adult age and have positive effect in gait ability and can play a positive role in the prevention of injuries and falls in senior age. In accordance with the author [4] can be discussed that found girth of thigh as negative predictor of gait in seniors can be connected with gynoid type, valgosity and strong physical activity limitation. Fat storage in the area of buttocks and thighs negatively affects the function of gait and other physical activities [4].

Conclusions

The study demonstrates that gait ability in seniors aged sixty five years old and over is significantly related to the physical, psychic and social indicators of quality of life. It was found significant correlations between indicators of bio-psycho-social items of quality of life, examined by SF-36 questionnaire with results of the Tinetti Gait Test. Significant negative impact on the gait ability in seniors had reduction of normal social activities in combination with disbelief in own good health. Further the physical problems or emotional problems interfered negatively with gait ability of seniors as well as negative impact on gait ability has been proven of pains.

Positive influence on the gait ability in seniors was found in correlation with certain robustness of the body character, what can be caused as a result of work and active movement or providing of regular physical activities during the life. Results of the study can be inspiration for application using in adapted physical activity research and in the field of kinesiology.

Acknowledgements

References

1. Bártlová S. Health literacy in selected population groups. Kontakt. 2018; 20(4): 317-318. DOI: //doi.org/10.1016/j.kontakt.2018.10.012.

2. Best H, Wolf Ch. The SAGE Handbook of Regression Analysis and Causal Inference. London: Sage; 2014.

3. Bridenbaugh SA, Kressig RW. Laboratory review: the role of gait analysis in seniors' mobility and fall prevention. Gerontology 2011; Oct 57: 256-264. DOI: 10.1159/000322194.

4. Bláha P. Funkční a sportovní antropologie – vybrané metody (Functional and sports anthropology – selected methods). Prague: College of PE and Sport PALESTRA; 2017.

5. Camicioli R, Rosano C. Understanding Gait in Aging – Part 1. International Parkinson and Movement Disorder Society. 2012, Apr. MDS Website Archives. Available from: https://www.movementdisorders.org/MDS/News/Online-Web-Edition/Archived-Editions/Series-on-Gait--Part-1.htm.

6. CSSZ. EU Přehled o počtu poplatníků pojistného a počtu důchodců (Overview of the number of premium payers and the number of pensioners). Prague: CSSZ; 2018. Available from: https://www.cssz.cz/cz/o-cssz/informace/statistiky/ekonomicke-ukazatele/prehled-vybranych-statistickych-a-ekonomickych-ukazatelu/prehled-vybranych-statistickych-a-ekonomickych-ukazatelu.htm.

7. European Commission. Public Health. Aging. The 2016 Call for Commitments of the European Innovation Partnership on Active and Healthy Ageing. Ec.europa.eu 10/02/2016. Available from: http://ec.europa.eu/health/ageing/innovation/index_en.

8. Gronek P, Holdys J. Genes and physical fitness. Trends Sport Sci. 2013; 20(1): 16-29.

9. Hahn A. Otoneurologie a tinitologie (Otoneurology and tinnitology). Praha: Grada; 2015.

10. Janečková B, Szabó K, Kalová H, Poncarová E, Petr P. The risk of falls in ambulatory and stationary care. Prevence úrazů, otrav a násilí (Prevention of injuries, poisoning and violence). 2013; 9(2):129-134.

11. Krejčí M, Hošek V. Identification characteristics of the intervention method „Life in Balance" focused on seniors 65+. Acta Salus Vitae. 2018; Nov 6(2): 45-54.

12. Krejčí M, Kornatovská Z. Yoga applications in persons with disabilities. In: Bolach E, Kawczynski A, editors. Adaptacyjna Aktywność Fizyczna (Adapted Physical Activity). Wroclaw: AWF; 2017. pp. 104-126.

13. Marcinko I. The moderating role of autonomous motivation on the relationship between subjective well-being and physical health. PloS one. 2015; Nov 10(5), e0126399. DOI: 10.1371/journal.pone.0126399.

14. Meloun M, Militky J, Hill M, Brereton RG. Crucial problems in regression modelling and their solutions. Analyst. 2002; Jun 127: 433-450.

15. Tinetti ME, Williams TF, Mayewski R. Fall Risk Index for elderly patients based on number of chronic disabilities. Am J Med. 1986; Jul 80: 429-434.
16. ÚZIS. Dotazník kvality života SF-36 (Life Quality Questionnaire SF-36). 2018. Available from: https://www.uzis.cz/dotaznik-kvality-zivota-sf-36.
17. Ware JE, Snow KK, Kosinski M, Gandek B. SF-36 Health Survey Manual and Interpretation Guide. Boston: The Health Institute Boston; 1993.