Balance and Gait Assessment and the Risk of Falls in Seniors During Hospitalization

Ocena równowagi i chodu a ryzyko upadków seniorów w przebiegu hospitalizacji

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Abstract

Introduction. Falls and mobility disorders are classified as large geriatric syndromes, which in turn lead to deficits in the functional fitness of the elderly.
Aim. Fall risk analysis in the group of hospitalized seniors, including socio-demographic variables.
Material and Methods. The research used the estimation and diagnostic survey method, the estimation scale technique and questionnaires. The research tool was the Tinetti questionnaire. The research was conducted among 100 seniors during their hospitalization.
Results. Seniors in younger age categories, with higher education level, married and living with a family, scored higher on the Tinetti scale.
Conclusions. Hospitalization, age advancement, lower education, single marital status and lonely household management by seniors significantly increased the risk of their falls. Gender was not a factor that significantly differentiated the risk of falling. **(JNNN 2020;9(4):127–131)**
Key Words: fall, older adults, risk

Streszczenie

Wstęp. Upadki oraz zaburzenia mobilności zaliczane są do wielkich zespołów geriatrycznych, które z kolei prowadzą do deficytów sprawności funkcjonalnej seniorów.
Cel. Analiza ryzyka upadków w grupie hospitalizowanych seniorów z uwzględnieniem zmiennych socjodemograficznych.
Materiał i metody. W badaniach zastosowano metodę szacowania oraz sondażu diagnostycznego, technikę skali szacunkowej i ankietowanie. Narzędziem badawczym był kwestionariusz skali Tinetti. Badania przeprowadzono wśród 100 seniorów w przebiegu ich hospitalizacji.
Wyniki. Seniorzy w młodszych kategoriach wiekowych, z wyższym poziomem wykształcenia, pozostający w związkach małżeńskich i mieszkający z rodziną uzyskiwali wyższe średnie punktów w skali Tinetti.
Wnioski. Hospitalizacja, zaawansowanie wieku, niższe wykształcenie, wolny stan cywilny oraz samotne prowadzenie gospodarstwa domowego przez seniorów istotnie zwiększały ryzyko ich upadków. Płeć nie była czynnikiem istotnie różnicującym ryzyko upadku. **(PNN 2020;9(4):127–131)**
Słowa kluczowe: upadek, osoby starsze, ryzyko

Introduction

According to the World Health Organization (WHO) position, falls are events in the course of which a person is unintentionally on the floor or other surface. This is the effect of the loss of balance [1–3]. Falls and mobility disorders are classified as large geriatric syndromes, which in turn lead to deficits in the functional efficiency of seniors, to a gradual loss of autonomy and increased dependence on help from other people [4,5].

According to the WHO Global Report on Falls Prevention in Older Age, falls are the result of the

interaction of four groups of factors: biological, behavioural, environmental and socioeconomic [1,2]. According to another classification, emphasizing the multifactorial etiology of falls, their external causes, resulting from living conditions, and internal ones, related to the health condition are indicated [6,7]. Recurring fall incidents rarely have a single cause [7–9].

The aim of the study is to analyse the risk of falls in the group of hospitalized seniors, taking into account socio-demographic variables.

Material and Methods

The research was conducted among people over 60 years of age hospitalized in the internal ward of the Provincial Specialist Hospital in Włocławek at the turn of 2019 and 2020. The hospital director and the Bioethics Committee of the State Vocational University in Włocławek (Resolution No. 43/19) approved of the research procedure.

The following criteria for including patients in the study were applied: respondents' age — 60 years and older, hospitalization in the internal ward of the hospital, consent by the respondent to participate in the study and no cognitive impairment.

The study used the assessment and diagnostic survey method, the estimation scale technique and questionnaire surveys. The research tool used in the study was the Tinetti Scale questionnaire, preceded by an original record with socio-demographic data. In the studies in question, a physiotherapist was involved in the assessment of the risk of falls. Tinetti scale — the POMA (Tinetti — Performance Oriented Mobility Assessment) scale of balance and gait, allows to determine the senior's difficulty in walking and maintaining balance. It enables the identification of imbalances and gait disturbances as well as the assessment of the risk of falls in the elderly [10,11]. Current research uses a version consisting of 16 tasks divided into two categories: gait and balance. The respondents could receive a maximum of 16 points for assessing the balance. The maximum gait score was 12. If the patient performed all the elements of the scale correctly, they received a total of 28 points. If the score was below 26 points, this indicated a problem that increased the risk of falling. The result below 19 points meant that the patient had a five times greater risk of falling than the person with the maximum score [12].

100 respondents took part in the research, including 58% women (58 people) and 42% men (42 people). Older adults were divided into three age groups: 60–74 years of age, 75–89 years of age and 90 years and more. The largest group included patients aged 60–74 (69 — 69%). 29% (29 people) of respondents were aged

75–89. Only 2 respondents (2%) were over 90 years old and the oldest patient was 92 years old. The average age of the respondents was just over 71 years of age.

Qualitative variables in the analysis of the research results are presented by frequency distributions. For quantitative variables, the mean and standard deviation were calculated. The verification of statistical hypotheses was carried out with the use of parametric methods. The following were used: Student's t-test for independent variables (in the case of unequal variances the Cochran–Cox correction was used), one-factor analysis of variance with the HSD post-hoc test. In the studies, the results were considered statistically significant when the value of the calculated test probability met the condition: $p < 0.05$. Statistical analysis was performed in the Statistica 10.0 package (Statsoft; 2011).

Results

The average score the seniors received in the balance test was 8.97 points, whereas in the gait test it was, 6.81 points. On the other hand, the average number of points obtained by the respondents in the Tinneti test was 15.78 points, which indicates a high risk of falling. The vast majority of respondents (67% — 67 people) obtained a Tinetti score below 19 points, which means that they show a five times greater risk of falling than those who obtained the maximum score (28 points). On average 20% (20 people) of seniors, in turn, had a result within 19–25 points, which indicates an increased risk of falling, whereas 13% (13 people) of the respondents obtained ≥26 points, which indicates slight deficits in terms of walking and maintaining balance.

In order to determine the influence of seniors' age on their results scored on the Tinetti Scale, an analysis was performed using the t-test with the Cochran–Cox correction for unequal variances. The comparisons were made for two groups of respondents: aged up to 74 and 75 or more. Statistically significant results ($p < 0.05$) were obtained both for the final test result for those surveyed and for the division of their fitness in terms of balance and gait. A higher overall average of points (17.74), i.e. a lower risk of falling, was characteristic of the younger age group of seniors (60–74 years), compared to the older category of respondents aged over 75, who obtained an average of 11.42 points. A similar situation occurred in the case of the assessment of seniors within the individual subscales of the Tinetti Scale. Younger patients obtained a higher mean number of points for both balance (10 points) and gait (7.74 points), compared to the mean score for the older group of patients (6.68 points and 4.74 points, respectively). The distribution of the results obtained on the Tinetti Scale in relation to the age of the respondents is presented in Table 1.

Table 1. Assessment of the respondents' balance and gait according to their age

Variable	Mean		SD		t	Df	p
	60–74 years	75 years and more	60–74 years	75 years and more			
Balance	10.00	6.68	4.00	3.33	4.03	68.80	p<0.001
Gait	7.74	4.74	3.29	2.68	4.44	70.17	p<0.001
Total	17.74	11.42	7.02	5.74	4.39	69.92	p<0.001

SD — standard deviation

Table 2. Assessment of the respondents' balance and gait according to their gender

Variable	Mean		SD		t	Df	p
	W	M	W	M			
Balance	8.93	9.02	4.21	3.98	−0.11	98	0.912
Gait	6.79	6.83	3.69	3.00	−0.06	98	0.954
Total	15.72	15.86	7.62	6.79	−0.09	98	0.928

SD — standard deviation

Table 3. Assessment of the respondents' balance and gait according their way of living

Variable	Mean		SD		t	Df	p
	with the family	Alone	with the family	Alone			
Balance	9.61	7.74	4.43	3.04	2.21	90.04	0.015
Gait	7.24	5.97	3.57	2.93	1.79	79.19	0.060
Total	16.85	13.71	7.80	5.56	2.09	87.92	0.023

SD — standard deviation

The analysis carried out with the use of the t (Student) test for independent variables did not show statistically significant differences between men and women in terms of the results obtained in the Tinetti test. Nevertheless, men in the final test scored a higher mean number of points (15.86) compared to women (15.72). The distribution of the results obtained on the Tinetti Scale in relation to the gender of the respondents is presented in Table 2.

As regards the balance and the result of the total Tinetti test, the analysis with the t-test including Cochran–Cox correction showed statistically significant differences (p<0.05) between the group of seniors living with their family/partner and those living alone. People who live with their families obtained better results in both subscales, i.e. they have a lower risk of falling. With regard to the assessment of seniors' gait, the result was statistically significant. In this case, higher mean points were also obtained by people living with their family. Respondents living with their family in the assessment of the balance test obtained a higher mean number of points (9.61), compared to those living alone (7.74). Similarly, in the assessment of gait, patients living with their families received a higher mean score (7.24), compared to those who lived alone (5.97). In the final

result of the Tinneti test, patients living with their family (16.85) had a significantly higher mean of points compared to those living alone (13.71). A detailed distribution of the results obtained on the Tinetti Scale in relation to the respondents' way of living is presented in Table 3.

In order to investigate the effect of the level of education on the risk of falling, a single-factor analysis of variance was performed. The results have shown that both in relation to the total value of the Tinetti test and its two components, the level of education is a statistically significant factor (p<0.05) differentiating the results obtained by hospitalized seniors. The average values of the results increase with the level of education. Multiple (post-hoc) comparisons were also performed with the use of the HSD Tukey test. In the test of balance, a higher mean of points was scored by respondents with higher education (12.20), as opposed to those with primary one (6.83). Also, in the gait test, seniors with higher education obtained a higher mean score (9.45), compared to older people with primary education (5.07). In the final result of the Tinneti test, the respondents with higher education had a much better average score (21.65) compared to those with primary education (11.90). A detailed distribution of the results obtained

Table 4. Assessment of the respondents' balance and gait according to their education

Variable	Education	Mean	SD	F	P	p (post-hoc)
Balance	G1: primary	6.83	3.55			G1-G2: p=0.571
	G2: vocational	8.03	3.62	10.70	<0.001	G1-G3: p=0.013
	G3: secondary	10.47	3.56			G1-G4: p<0.001
						G2-G3: p=0.163
						G2-G4: p=0.002
	G4: higher	12.20	3.66			G3-G4: p=0.454
Gait	G1: primary	5.07	2.98			G1-G2: p=0.720
	G2: vocational	5.87	2.68			G1-G3: p=0.006
				11.41	<0.001	G1-G4: p<0.001
	G3: secondary	8.32	2.96			G2-G3: p=0.060
						G2-G4: p=0.001
	G4: higher	9.45	3.35			G3-G4: p=0.642
Total	G1: primary	11.90	6.19			G1-G2: p=0.605
	G2: vocational	13.90	5.92			G1-G3: p=0.006
				12.05	<0.001	G1-G4: p<0.001
	G3: secondary	18.79	6.36			G2-G3: p=0.080
						G2-G4: p=0.001
	G4: higher	21.65	6.81			G3-G4: p=0.498

SD — standard deviation

Table 5. Assessment of the respondents' balance and gait according to their marital status

Variable	Mean		SD		t	Df	p
	Single	Married	Single	Married			
Balance	7.04	11.24	3.13	3.95	−5.83	85.22	<0.001
Gait	5.24	8.65	2.78	3.15	−5.69	90.66	<0.001
Total	12.28	19.89	5.52	6.90	−6.02	85.79	<0.001

SD — standard deviation

on the Tinetti Scale in relation to the education of the respondents is presented in Table 4.

The influence of marital status on the results of the Tinetti test was assessed using the t-test with the Cochran–Cox correction. The comparisons were made with a division into two groups: single persons (unmarried/single men and women as well as widows and widowers) and married ones. The analysis showed the existence of statistically significant differences ($p<0.05$) between the average score obtained by the respondents in relation to the total score as well as to its both components. Those living in a married relationship (19.89 points) had a higher average score (i.e. a lower risk of falling) than unmarried respondents (12.28 points). Married respondents of both sexes obtained a higher mean number of points (11.24) in the balancing test compared to those who were single (7.04). Similarly, in the assessment of gait, married patients received a higher mean score (8.65), compared to the unmarried respondents (5.24). The distribution of the results obtained on the Tinetti Scale in relation to the marital status of the respondents is presented in Table 5.

Discussion

Falls in residential and communal environments are the subject of numerous studies. Hospitalization of older adults constitutes a significant risk factor for falls in relation to all hospital wards, particularly geriatric wards where elderly people are present [13]. This is confirmed by the results of our own research indicating a high risk of the aforementioned phenomenon in the group of elderly people who were patients of internal medicine wards. Older people who live in nursing homes experience a fall more often than those living in their own place of residence. It is estimated that approximately 30–50% of people covered by long-term care fall each year. In turn, 40% of them experience this incident more than once [1,2,14].

The incidence of falls increases with the age of older people. The results of own research have shown that people aged 75 and more have a higher risk of falling. Statistics show that each year the above incident affects approximately 28–35% of people aged 65 or more and approximately 32–42% of seniors over 70 years of age [1,2,14]. The PolSenior study, which concerned elderly people staying in the living environment, confirmed that the frequency of falls increases with age. In the group of seniors aged 65–69, falls concerned about 12% of them, and in the case of respondents aged over 89 it referred to 36% [4,15]. Among the reasons for falls confirmed under the EBM criteria (Evidence-based medicine), one can distinguish, inter alia, gait and balance disorders, and an age of at least 80 years [2,16].

In our own research, gender was not a factor that significantly differentiated the risk of falling. Nevertheless, men in the final test score obtained a higher average number of points compared to women. According to the WHO Global Report on Falls Prevention in Older Age, biological risk factors for falls include non-modifiable factors, such as: age, gender and race, associated with involutional changes [1,2].

In the authors' own research, the risk of falls in hospitalized seniors decreased significantly with the rise in the level of education. Similar results concerned studies conducted by Bartoszek et al. among seniors in a rural environment. It has been shown that people with primary education were more at risk of falling [17].

In the authors' own research, the way of living and the marital status of seniors significantly influenced differences in the assessment of the risk of their falls.

Elderly married people who lived with their families presented a lower risk of falling compared to the unmarried ones living on their own. In their research results, Bartoszek et al. indicate that seniors living alone are at a higher risk of falling than those who live with their families [17].

Conclusions

Hospitalization, age advancement, lower education, single marital status and single household management by seniors significantly increased the risk of their falls. Gender was not a factor that significantly differentiated the risk of falling.

Implications for Nursing Practice

Systematic verification of risk factors for falls and the use of standardized scales in the assessment of seniors allow to plan effective measures to prevent falls among elderly people.

References

[1] World Health Organization. *WHO Global Report on Falls Prevention in Older Age*. Retrieved December 4, 2020, from https://www.who.int/ageing/publications/ Falls_prevention7March.pdf?ua=1]

[2] Kamińska M.S. Rola pielęgniarki rodzinnej w prewencji upadków w grupie pacjentów w wieku geriatrycznym. *Fam Med Primary Care Rev.* 2013;15(1):21–26.

[3] Krysińska M., Domosławska-Żylińska K., Fronk M. (Red.), *Urazy wśród osób powyżej 60-go roku życia — raport*. Narodowy Instytut Zdrowia Publicznego — Państwowy Zakład Higieny, Warszawa 2017, https:// www.pzh.gov.pl/wp-content/uploads/2018/11/Urazy-raport.pdf [dostęp: 4.12.2020].

[4] Borowicz A.M., Pawlaczyk M., Korzeniowska K. Zjawisko wielolekowości a ryzyko upadków u osób starszych mieszkających w Domach Pomocy Społecznej — badanie pilotażowe. *Farmacja Współcz.* 2014;7:3–8.

[5] Wojszel B., Bień B., Przydatek M. Wielkie problemy geriatryczne: II. Upadki. *Med Rodz.* 2001;2:83–86.

[6] Ganz D.A., Bao Y., Shekelle P.G., Rubenstein L.Z. Will my patient fall? *JAMA*. 2007;297(1):77–86.

[7] Szczerbińska K. Okoliczności i czynniki ryzyka upadków powtarzających się i występujących sporadycznie w domach pomocy społecznej. *Gerontol Pol.* 2011;19(3–4):161–170.

[8] Hauer K., Lamb S.E., Jorstad E.C., Todd C., Becker C., PROFANE-Group. Systematic review of definitions and methods of measuring falls in randomised controlled fall prevention trials. *Age Ageing.* 2006;35(1):5–10.

[9] Stalenhoef P.A., Diederiks J.P., Knottnerus J.A., Kester A.D., Crebolder H.F. A risk model for the prediction of recurrent falls in community-dwelling elderly: a prospective cohort study. *J Clin Epidemiol.* 2002;55(11):1088–1094.

[10] Biercewicz M. Wybrane skale punktowe stosowane w geriatrycznej ocenie stanu chorego. *Pielęgniarstwo w Opiece Długoterminowej.* 2019;1:59–65.

[11] Tinetti M.E. Performance-oriented assessment of mobility problems in elderly patients. *J Am Geriatr Soc.* 1986;34(2): 119–126.

[12] Borowicz A.M., Wieczorowska-Tobis K. Ocena ryzyka upadku u osób starszych przebywających na oddziale rehabilitacyjnym. *Geriatria.* 2011;5:13–18.

[13] Mazur K., Otremba I., Bieniek J., Szewieczek J. Upadki chorych hospitalizowanych na oddziale geriatrycznym. *Ann Acad Med Siles.* 2014;68(4):218–225.

[14] Masud T., Morris R.O. Epidemiology of falls. *Age Ageing.* 2001;30(Suppl 4):3–7.

[15] Skalska A., Wizner B., Klich-Rączka A., Piotrowicz K., Grodzicki T. Upadki i ich następstwa w populacji osób starszych w Polsce. Złamania bliższego końca kości udowej i endoprotezoplastyka stawów biodrowych. W: Mossakowska M., Więcek A., Błędowski P. (Red.), *Aspekty medyczne, psychologiczne, socjologiczne i ekonomiczne starzenia się ludzi w Polsce*. Termedia Wydawnictwa Medyczne, Poznań 2012;275–294.

[16] Czerwiński E., Borowy P., Jasiak B. Współczesne zasady zapobiegania upadkom z wykorzystaniem rehabilitacji. *Ortop Traumatol Rehab.* 2006;8(4):380–387.

[17] Bartoszek A., Kocka K., Bartoszek A., Ślusarska B., Nowicki G., Jamrozik K. Wybrane czynniki ryzyka upadków wśród osób starszych mieszkających w środowisku wiejskim. *J Educ Health Sport.* 2016;6(8): 625–636.

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