Original article:

Relationship between body mass index, balance, ortostatic hypotensionand risk of fallingin elderly

(Observational Analytical Study in the Elderly at the Pucang Gading Nursing Home Pedurungan District, Semarang)

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Abstract:

Background: One of the health problem related to aging includes fall that can cause an increase in morbidity and limitation in activities. Other factors that affect falls includes nutritional status, balance and hemodynamic disturbances. ***Methods:*** observational analytic study with cross-sectional study design. The independent variable was risk of falling in the elderly and the dependent variable was body mass index (BMI), balance and orthostatic hypotension. The instruments used in this study were Morse Fall Scaleto assessrisk of falling, Body mass index (BMI) to assess nutritional status, and Short Physical PerformanceBattery(SPPB), a series of tests were used to assess balance in the elderly. An orthostatic hypotension was measured using sphygmomanometer. ***Results:*** Most of the elderly 32 (68.1%) had a normoweight. A total of 31 elderly had moderate body balance score, and 39 (89%) of elderly had an orthostatic hypotension. The number of elderly withlow risk of falling was 30 (63.8%). There was no relationship between BMI and and the risk of falling (p=0.064). There was a relationship between body balance and the risk of falling in the elderly Pucang Gading Nursing HomeSemarang (p<0.05, r=-0.497). There was no relationship between orthostatic hypotension and the risk of falls (p=0.974). ***Conclusion:*** There is no relationship between BMI, orthostatic hypotension and the risk of falling. There is a relationship between balance and risk of fallingin the elderly

Keywords: BMI, orthostatic hypotension, balance, risk of falling, elderly

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Introduction

Oneof the aging related health problems is fallwhich cause an increase in morbidity and limitations in activities. Factors affectingthe risk of falling include a history of previous falls, muscle strength, balance disorders and the way of walking and medications[1]. Other factors affecting falls include disturbance in nutritional status, in which malnutrition can increase the risk of falls in the elderly. Another study showed that elderly with obesity have higher risk of falls and feel more pain than those without obesity. It also showed that falls in older people obesity will cause more pain and less ability to do the activities.

Previous studies used a short physical performance battery (SPPB), a series of tests consisting walking speed test, a standing test and a balance test. SPPB has been used as a tool to predict disability and monitorfunction in the hospitalized elderly. Using themethod, the weakest patient with a poor score had a significant risk of falls.[2] Another studies concluded thatthe criteria of SPPBscoring in hospitals may be appropriate when used in the elderly population in the nursing home.

According to previous research, there is a relationship between orthostatic hypotension and the risk of falls in elderly with hypertension. There are several measuring instruments to determine

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the nutritional status in elderly including the body mass index (BMI). The short physical performance battery (SPPB) is a series of tests consisting of walking speed test, test and test sitting standing balance. SPPB has been used as a predictive tool for possible disability and monitoring tool for function in the elderly. The standard of blood pressure measurement using mercury sphygmomanometer can be used to determine orthostatic hypotension in elderly.[3]

The risk of falls in the elderly can be evaluated using Morse's fall scale(MFS) to assess history of previous falls, a diagnosis of secondary disease, the use of assistive devices, disturbances in walking and mental health.[4.5] Therefore, this study aimed to determine the relationship between the body mass index, balance and orthostatic hypotension and the risk of falls in the elderly. By knowing this, it is expected to reduce the morbidity rate in the elderly and reduce the dependency ratio.

Research Method

observational analytic research using cross-sectional design. The independent variable was risk of falling in the elderly, the dependent variable was BMI, balance and orthostatic hypotension.

The Operational Definition

Risk of falling in the elderly is common in nursing homes. The risk of falling for the last three months was evaluated. The questionnaire used was Morse Fall Scale with three criteria of risk of falling includinglow (total score ≤ 20), moderate (total score 25-40) and high (total score ≥ 45) using ordinal scale.

The body mass index (BMI) is weight in kilogram divided by the square of height in meter. The body mass index are classified into: underweight, adequate nutrition (normal), overweight and obesity with an ordinal scale.

Body balance assessed using Short Physical Performance Battery (SPPB) was the sum of scores from 3 tests including walking speed test, a standing test and a balance test. There is a potential range of 0-12, with higher scores indicating better body functions. Where people who have poor grades significantly increase their risk of falling. The score is classified into low (0-4), moderate (5-8), high (9-12) in which subjects with poor grades/ scores? significantly increase their risk fall with an ordinal scale.

Orthostatic hypotension was measured using a sphygmomanometer todetermine decrease in systolic or diastolic blood pressure. Orthostatic hypotension is divided into 2 categories: a decrease in systolic blood pressure of ≥ 20 mmHg or diastolic blood pressure ≥ 10 mmHg and those without a decrease in blood pressure by systole blood pressure of ≥ 20 mmHg or diastolic blood pressure ≥ 10 mmHg. Blood pressure was measured 3 times in different positions, namely: lying, sitting and standing with a nominal scale.

The population in this study was the eligible elderly staying in the Pucang Gading nursing home Pedurungan District, Semarang municipality

The number of samples/subjects? needed for the relationship between body balance and risk of falls in the elderly was 47 respondents. Selection of samples was conducted with consecutive sampling.

This study on the relationship between body mass index, balance and orthostatic hypotension with the risk of falls in elderly was conducted in Pucang Gading nursing home in Pedurungan District of Semarang between October 21, 2018 and December 2, 2018.

Results and Discussion

Results

This research is an analytic observational study using cross sectional study design aimed to investigate the relationship between body mass index, orthostatic hypotension, body balance with risk of falling in the elderly in a nursing home in Semarang. The study was conducted on 21 October 2018 - 2 December 2018 in the elderly aged ≥ 60 years with the criteria of being able to answer and follow the instructions of the researcher as well as cooperatively contribute to the data collection. This research was approved by the board of health research ethics and medical commission of the Faculty of Medicine, Sultan Agung Islamic University, Semarang. The elders who were included in this study were given information about the study and signed an informed consent before the commencement of the study.

During the study the total population of the study was carried out by 99 elderly who lived in Pucang Gading nursing home in Semarang municipality from October to December 2018, where 47 elderly met the inclusion criteria. As many as 52 elderly were excluded because 40 elderly were very dependent

on walking aids, 8 elderly were not cooperative, 2 elderly were obese, 1 elderly could not see and 1 elderly died before the research data were collected .

The characteristics of the elderly in Pucang Gading Nursing Home Semarang in this study is illustrated in Table 4.1.

Characteristics	Mean ± Standard Deviation	Frequency	Percentage
Gender			
Women		29	61,7
Man		18	38.3
Age	72.49 ± 8.67		
60-69		25	53.2
70-79		8	17.0
> 80		14	29.8
Length of stay in the home	30.32 ± 31.94		
1-12		15	31.9
13-24		13	27.7
25-36		7	14.9
37-48		4	8.5
> 48		8	17.0
Body mass index			
Underweight		10	21.3
Normal		32	68,1
Overweight		5	10.6
Orthostatic hypotension			
Yes		8	17.0
Not		39	83.0
Body Balance			
Low		6	12.8
moderate		31	66.0
High		10	21.3
Risk of falling			
Low		30	63.8
moderate		9	19.1
High		8	17.0

The age of the study subjects ranged from 60-91 years, grouped into the elderly (60-74 years) and old (75-90 years). The results showed that most of the study subjects (63.8%) was elderly with length of stay of 1 - 118 months with an average of 30.32 ± 31.9 months. The elderly in Pucang Gading Semarang Nursing Home who participated in this study were mostly female (61.7%). The results of calculation of BMI ranged from 14.34 to 29.11 kg/ m^2 with an average of 20.95 ± 0.48 kg /$m^{2.}$ The classification of BMI categories showed that 68.1% elderly subjects in Pucang Gading Semarang Nursing Home had a normal BMI, underweight elderly accounted for 21.3% and the remaining 10.3% were overweight. Orthostatic hypotension was found in 8 (17.0%) respondents and 39 (83.0%) respondents did not experience orthostatic hypotension. The highest number of elderly body balance was categorized into moderate (66.0%) followed by high (21.3%) and low (12.8%). the low, moderate, high risk of falling accounted for (63.8%), 19.1% and 8 17.0%, respectively.

The relationship between BMI and the risk of falls in the elders is presented in Table 4.4

Table 4 2 Relationship between BMI and risk of falling in the elders

BMI	Risk of Falling [n, (%)]			Total	p	r
	Low	Medium	High			
Underweight	9 (90.0%)	0 (0.0%)	1 (10.0%)	10 (100%)	0,064	0,272
Normal	19 (59.4%)	7 (21.9%)	6 (18.8%)	32 (100%)		
Overweight	2 (40.0%)	2 (40.0%)	1 (20.0%)	5 (100%)		
Total	6 (12.8%)	31 (66.0%)	10 (21.3%)	47 (100%)		

Remarks: 5 (55.6%) cells have expected count <5

Table 4. 2 shows that of the most of the 10 underweight elders had a low risk of falling. Ten presence had a high risk of falling. In the elders with a partial normal BMI (59.4%) the risk of falling was low; 21.9% had a moderate; and 18.8% had a high risk of falls. In the overweight elderly each of 40.0% had a low and moderate risk of falling and 20% risking falling high. Spearman correlation test obtained p value of 0.064 (p> 0.05), meaning that there was no relationship between BMI and the risk of falls in the elderly at Pucang Gading nursing homeSemarang.

Table 4 3 Relationship between Orthostatic Hypotension to Risk of Falling

		Risk of falls			Correlation coefficient (r)	P value
		Low	Normal	High		
Orthostatic hypotension	Yes	5	2	1	0.005	0.974
	Not	25	7	7		
Total		**30**	**9**	**8**		

Spearman rank correlationTest

Table 4.3 shows that of the 8 elderly who have orthostatic hypotension 5 of them had a low risk of falling 2 had moderate risk and 1 had a high risk of falling. From the results of the Spearman rank correlation test in table 4.5, the p value was 0.974 (p> 0.05) meaning that that there was no significant relationship between orthostatic hypotension and the risk of falling.

Table 4 4 Relationship between body balance and risk of falling in the elders

Body balance	Risk of Falls [n,(%)]			p	r
	Low	Moderate	High		
Low	1 (16.7%)	2 (33.3%)	3 (50.0%)	0.000	-0.497
Moderate	19 (61.3%)	7 (22.6%)	5 (16.1%)		
High	10 (100%)	0 (0.0%)	0 (0.0%)		
Total	30 (63.8%)	9 (19.1%)	8 (17.0%)		

Table 4. 4 shows that out of the 6 elders, 50% had a high risk of falls, 33.3% had a moderate risk and 16.7% had a low risk of falling. Of the 31 elderly with moderate body balance most (61.3%) had low risk of falling, 22.6% had medium risk of falling and 16.1% had highrisk of falling. Of the 10 elderly with high body balance all was showed low risk fall. The results of the Spearman correlation test obtained p value of 0.000 ($p < 0.05$), meaning that there was a relationship between body balance and the risk of falling in the elders at Pucang Gading NursingHome Semarang. The r value of -0.497 indicates that the level of closeness between the body balance and the risk of falling in the elderly was classified into moderate. The negative correlation (r) value indicates the lower the balance of the elders, body the higher risk of the fall they have.

Discussion

The general characteristics of the subjects in the study were 29 elderly women and 18 elderly men . Gender is one of the intrinsic factors affecting the risk of falling in the elderly meaning that elderly women had a higher risk of falling than men the causes of falls in women are specifically caused by urinary incontinence while in men the cause is due to balance and depression. Most respondents in this study were 60-69 years old with an average age of 72.49 with standard deviation of 8.67. About one third of adults over the age of 65 fall every year[6] According to the data, most respondents stayed in the nursing home for 1-12 months with average of 30.32 months with a standard deviation of 31.94. The elders who lived in nursing homes for the first 6 months experienced depression, while depression was one of the factors that caused the risk of falling.

This study showed that the Body Mass Index was not correlated with the risk of falling in the elders. This is consistent with previous research findings showing that there is no relationship between the Body Mass Index and the risk of falling.[7] This is due to the fact that risk of falling can happen because it is caused by multidimensional factors including the history of previous falls, muscle strength, impaired balance and gait, routinely consumed drugs.[1]Factors related to the aging process, the process of occurring the disease and the activities carried out [8] .

This study finds that orthostatic hypotension is not associated with risk of falling that occurs in the elderly. This is contraryto previous research which states that a decrease in systolic or diastolic blood pressure can increase the risk of falling in the elderly.[9] and other studies regarding the incidence of orthostatic hypotension have an effect on the risk of falls in hypertensive elderly people.[10] The risk of falling is influenced by various internal and external factors such as hearing and vision disorders, neuromuscular changes, physical and neuropsychiatric conditions, environmental conditions, use of drugs, walking aids and accidents. Based on the characteristics of the research subjects, it was found that the elderly who experienced orthostatic hypotension could control and minimize the risk of falls so that the elderly with orthostatic hypotension had a low risk of falling. In the elderly with high risk of falling there is no orthostatic hypotension detected. Elderly people who experience a secondary diagnosis of hypertension can control their blood pressure so reducing the incidence of orthostatic hypotension is explained by previous researchers who explained that the incidence of orthostatic hypotension was not associated with the risk of falling in well-controlled hypertension.[11]Furthermore, there were found elderlies with a high risk of falling due to slippery floors and tripping due to uneven floor surface, these events were external factors of risk of falling, previous researchers explained that environmental factors that cause falls to the elderly are the condition of the slippery floor and walking do not use footwear [12] .

In this study the relationship between body balance and the risk of falls in the elderly is evident. Of the 10 elderlies with high body balance all had a low risk falls. The results of previous studies showed that balance disorders are common in the elderly. About one in five elderly shows a significant prevalence of the problem of balance in daily activities [13]. Thus, balance disorders can be dangerous for the risk of falls and injuries resulting in hospital care and nursing homes [14]. Balance

disorders can cause falls because there are disorders of the inner ear vestibular system which play an important role in balance control leading to a high prevalence of vestibular associate with the risk of falls [15]. This is consistent with research findings showing that there is a correlation between body balance and a history of falls in the elders at *Posyandu Lansia Aisyiyah* Pucangan and Posyandu Benowo Karanganyar Village [16]

The limitation of this study was relatively small sample size resulting in less representative findings. In addition, it is necessary to explore one by one the factors affecting body mass index, body balance and risk of falling.

Conclusion

This study resulted in the relationship between Body Mass Index , Orthostatic Hypotension, Body Balance with Risk of Falling in the Elderly at Pucang Gading Nursing Home, Semarang municipality. The result of data analyzed using Spearman Rank Correlation are as follows: Most subjects (32/68.1%) had a body mass index classified into normoweight 32 (68.1%). In termof body balance, most (31/66.0%) had risk of moderate risk of fall. In term of Orthostatic Hypotension, most (39 /83.0%) had orthostatic hypotension .The low risk of fall was found in most of the elderly (30 /63.8%).There was no correlationbetween body mass index and the risk of falls in elderly at *Panti Wredha of Pucang Gading*, Semarang.There is a correlationbetween body balance and the risk of falls in the elderly in Pucang gadingnursing home , Semarang ($p < 0.05$, $r = -0.4970$.There was no correlations between orthostatic hypotension and the risk of falling in the elderly at *Pucang Gading* Nursing Home Semarang.

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References:

1. Tinetti, M., & Kumar, C. (2010). The patient who falls:"It's always a trade-off." *Jama*, *303*(3), 258–266. https://doi.org/10.1001/jama.2009.2024.
2. Fisher, S., Ottenbacher, K. J., Goodwin, J. S., Graham, J. E., & Ostir, G. V. (2009). *Short physical performance battery in hospitalized older adults*. *Aging Clinical and Experimental Research*, *21*(6), 445–452. https://doi.org/10.1007/BF03327444
3. Ma, Y., Temprosa, M., Fowler, S., Prineas, R. J., Montez, M. G., Brown-Friday, J., … Whittington, T. (2009). *Evaluating the accuracy of an aneroid sphygmomanometer in a clinical trial setting*. *American Journal of Hypertension*, *22*(3), 263–266. https://doi.org/10.1038/ajh.2008.338
4. Morse, J. M. (2002). *Preventing patient falls. Establishing a Fall Intervention Program*. *Age and ageing* (Vol. 31). https://doi.org/10.1093/ageing/31.1.75
5. Morse, J. M. (2009). *Preventing Patient Falls*. (A. Graubard, Ed.) (2nd ed.). New York: Springer Publishing Company
6. Ambrose, A. F., Paul, G., & Hausdorff, J. M. (2013). Risk factors for falls among older adults: A review of the literature. *Maturitas*, *75*(1), 51–61. https://doi.org/10.1016/j.maturitas.2013.02.009
7. Hergenroeder, A. L., Wert, D. M., Elizabeth, S., Studenski, S. A., Brach, J. S., Hergenroeder, A. L., … Brach, J. S. (2011). Research Report Measures of Balance and Mobility. https://doi.org/10.2522/ptj.20100214
8. Danielsen, A., Olofsen, H., & Bremdal, B. A. (2016). Increasing ri awareness using wearables: A awareness protocol. *Journal of Biomedical Informatics*, *63*, 184–194. https://doi.org/10.1016/j.jbi.2016.08.016
9. Klein, D., Nagel, G., Kleiner, A., Ulmer, H., Rehberger, B., Concin, H., & Rapp, K. (2013). B*lood pressure and falls in community-dwelling people aged 60 years and older in the VHM & PP cohort.*
10. Arga, S. (2016). *Hubungan hipotensi ortostatik terhadap risiko jatuh pada pasien lanjut usia dengan hipertensi*. Universitas Syah Kuala.
11. Gangavati, A., Hajjar, I., Quach, L., Jones, richard N., K, K., Gagnon, P., & Lipsitz, L. A. (2012). NIH Public Access, *59*(3), 383–389. https://doi.org/10.1111/j.1532-5415.2011.03317.x.Hypertension
12. Sabatini, S. N., Kusuma, H. E., & Tambunan, L. (2015). Faktor Eksternal Risiko Jatuh Lansia : Studi Empiris. *Temu Ilmiah IPBLI*, (1), 59–63.
13. Lin, H. W., & Bhattacharyya, N. (2012). Balance Disorders in the Elderly : Epidemiology and Functional Impact, (August), 1858–1861. https://doi.org/10.1002/lary.23376
14. Viswanathan, A., & Sudarsky, L. (2011). *Balance and gait problems in the elderly*. *Handbook of Clinical Neurology* (1st ed., Vol. 103). Elsevier B.V. https://doi.org/10.1016/B978-0-444-51892-7.00045-0
15. Schubert, M. C., & Minor, L. B. (2015). Disorders of Balance and Vestibular Function in US Adults, *169*(10), 2001–2004.
16. Arianda, R. (2014). Hubungan Antara Keseimbangan Tubuh Dengan Riwayat Jatuh Pada Lanjut Usia. *Hubungan Antara Keseimbangan Tubuh Dengan Riwayat Jatuh Pada Lanjut Usia*, (1), 1–5. https://doi.org/10.1007/s13398-014-0173-7.2