Significance of Specificity of Tinetti B-poma Test and Fall Risk Factor in Third Age of Life

Dijana Avdić[1]*, Džemal Pecar[2]

1. Orthopaedic and Trauma Clinic, Clinical Centre University of Sarajevo, Bolnička 25, 71 000 Sarajevo, Bosnia and Herzegovina
2. Policlinic "Praxis", Center for Physical Medicine and Rehabilitation, Ćumurija 3, 71 000 Sarajevo, Bosnia and Herzegovina

* Corresponding author

Abstract

As for the third age, psychophysical abilities of humans gradually decrease, while the ability of adaptation to endogenous and exogenous burdens is going down. In 1987, "Harada" et al. (1) have found out that 9,5 million persons in USA have difficulties running daily activities, while 59% of them (which is 5,6 million) are older than 65 years in age. The study has encompassed 77 questioned persons of both sexes with their average age 71,73 ± 5,63 (scope of 65 - 90 years in age), chosen by random sampling. Each patient has been questioned in his/her own home and familiar to great extent with the methodology and aims of the questionnaire. Percentage of questioned women was 64,94% (50 patients) while the percentage for men was 35,06% (27 patients). As for the value of risk factor score achieved conducting the questionnaire and B-POMA test, there are statistically significant differences between men and women, as well as between patients who fell and those who never did. As for the way of life (alone or in the community), there are no significant statistical differences. Average results gained through B-POMA test in this study are statistically significantly higher in men and patients who did not provide data about falling, while there was no statistically significant difference in the way of life. In relation to the percentage of maximum number of positive answers to particular questions, regarding gender, way of life and the data about falling, there were no statistically significant differences between the value of B-POMA test and the risk factor score (the questionnaire).

KEY WORDS: nitric oxide, serum, renal tissue, unilateral nephrectomy.

Introduction

Each person can fall down during moving, though falls are much to frequent in people of third age. The emergence of more frequent falls during movement in this population is related to aging that is with existence of different chronic diseases and disablements, which are predispositions for a fall. Aging is followed by changes in neurological, muscular and bone status. Muscular atrophy is most often the result of decrease in number of the muscle threads, not the change in their size. This is closely related to the loss of functionality of motorical units. Deterioration of muscular strength limits the functional capacity and contributes to the fall factor in third age. It is each year that one third of persons of third age falls at least once, in which a quarter suffers from serious injuries, another quarter limiting their activities due to the fall fear (2,3,4). As for the screening, which can trace specific damage, which can be conducted by both medical and non-medical staff, provided they are trained, clinical estimation methods (5) are used. One of to-day used clinical evaluation methods capable for screening is Tinetti B-POMA test (2).

Aim of Work

The aim of work is conduction of questioning the fall risk factor and Tinetti B-POMA test in order to trace down specifics for these tests.

Questioned Persons and Research Methods

All questioned persons have been checked by physical specialist at the beginning of the questioning as well as after six months. Questionnaire list has been particularly made for each questioned person, consisting of risk factors (Annex 1). Questionnaire consists of 22 questions, which are scored in dichotomy manner ("yes" or "no"). The summary of positive answers represents the approximate fall risk index. This evaluation is based on observation of researchers, answers of questioned persons and data available from other medical documentation. Tinetti B-POMA (Performance - Oriented Mobility Assessment) consists of 13 tasks, which are scored based on previously defined quality criteria. Each task will be scored with two (normal), one (adaptive answer) or zero (abnormal answer). Maximum score is 26, while higher values present better balance as well. Six months after beginning of the questionnaire research, all persons were asked how many times they fell in past six month. The fall is defined as each happening, which led towards unplanned and unexpected contact of the body, knee or arms with the layer beneath the belt level of the questioned person while standing (6). For example, this means that the fall also presents the loss of balance on the stairs, grabbing the handle or the wall. Only those with two or more falls in the defined period were questioned. Based on data achieved, all questioned persons were divided into two groups: the group with fall and the group without falls. The results have been statistically processed through SPSS programme, version 9.0, providing tables and graphics. Distribution, frequencies, central tendency measures, particularity, sensitivity, positive and negative predictable value, percents of positive and false negative results and reliability of positive and negative screening were set for each clinical test. "Cut-off" value has been set with the aid of ROC (receiver operating characteristic) chart. The correlation has been defined by Spearman correlation coefficient. With the help of the test, it has been stated which questioned variables have significant differences. In order to define individual variables, which are predictable for fall, logistical regression analysis has been conducted. The dependent variable was presented with the fall data (0- no fall, 1 – fall).

Results

3 out of 80 persons questioned were excluded from the study: one patient has MMSE test value less that 20, while another deceased. The third one had a stroke. 77 persons participated in the study: 27 men (35,06%) and 50 women (64,94%). Chart 1 presents the distribution of the questioned persons. Average age is 71,23 ± 5,63 (scope from 65 to 90 years): for women 71,22 ± 5,80 (scope from 65 to 90 years),

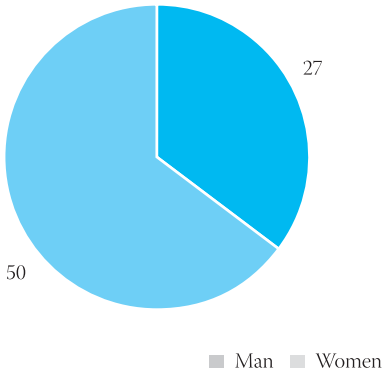


CHART 1. Distribution of questioned persons as per gender

PERIMETER	Men		Women		Total	
	N	%	N	%	N	%
No education	0	0	2	4	2	2,60
Basic education	2	7,41	28	56	30	38,96
College / High school	16	59,26	18	36	34	44,16
Higher or graduate degree	9	33,33	2	4	11	14,29
Total	27	100	50	100	77	100

TABLE 1. The level of education in relation to gender

for men 72,67 ± 5,26 (scope from 65 to 82 years). Two questioned persons (both women) had no education at all. 30 out of questioned persons had only basic education (38,96%), 34 questioned persons high school education (44,16%) while 11 questioned persons had higher or graduate degree. The level of education in relation to gender is shown in Table 1. A for this study, there is a statistically significant difference in the level of education: $p < 0,001$ (value of t - test 5,768). In the period of the study conduct, 21 questioned persons (27,27%) fell

PERIMETER	Men		Women		Total	
	N	%	N	%	N	%
Lives alone	5	18,52	18	36	23	29,87
Lives within a community	22	81,48	32	64	54	70,13
Total	27	100	50	100	77	100

TABLE 2. Distribution of questioned persons in relation to gender and way of living

PERIMETER	Men		Women		Total	
	N	%	N	%	N	%
Fall	4	14,81	17	34	21	27,27
No fall	23	85,19	33	66	56	72,73
Total	27	100	50	100	77	100

TABLE 3. Distribution of questioned persons as per gender, in relation to the fall data

PERIMETER	FALL (n)			NO FALL (n)			TOTAL (n)		
	M	W	S	M	W	S	M	W	S
Lives alone	1	8	9	4	10	14	5	18	23
Lives within a community	3	9	12	19	23	42	22	32	54
Total	4	17	21	23	33	56	27	50	77

TABLE 4. Distribution of questioned persons per data on fall, in relation to the way of living and gender

PERIMETER	Men	Women	Total
Risk factor score	2,59 ± 3,35	5,32 ± 3,71	4,36 ± 3,80
B-POMA test	23,6 ± 6,6	19,7 ± 7,0	21,1 ± 7,1

TABLE 5. Average risk factor score values and B-POMA test according to gender

PERIMETER	Lives alone	Lives in a community	Total
Risk factor score	4,87 ± 3,75	4,15 ± 3,83	4,36 ± 3,80
B-POMA test	19,9 ± 6,8	21,6 ± 7,2	21,1 ± 7,1

TABLE 6. Average risk factor score and B-POMA test in accordance with the way of living

PERIMETER	Fall	No fall	Total
Risk factor score	8,33 ± 3,07	2,88 ± 2,87	4,36 ± 3,80
B-POMA test	15,8 ± 7,3	23,1 ± 5,9	21,1 ± 7,1

TABLE 7. Average risk factor score values and B-POMA test in relation with the fall data

PERIMETER	Value of t-test	Liberty level	Stat. significance
Risk factor score	3,183	75	p < 0,005
B-POMA test	2,411	75	p < 0,01

TABLE 8. Testing of significant differences between men and women for particular tests

PERIMETER	Value of t-test	Liberty level	Stat. significance
Risk factor score	0,761	75	N.S. p > 0,05
B-POMA test	0,967	75	N.S. p > 0,05

TABLE 9. Testing significance between particular tests for questioned persons living alone or those living in a community

PERIMETER	Value of t-test	Liberty levels	Stat. significance
Risk factor score	7,298	75	p < 0,001
B-POMA test	4,513	75	p < 0,001

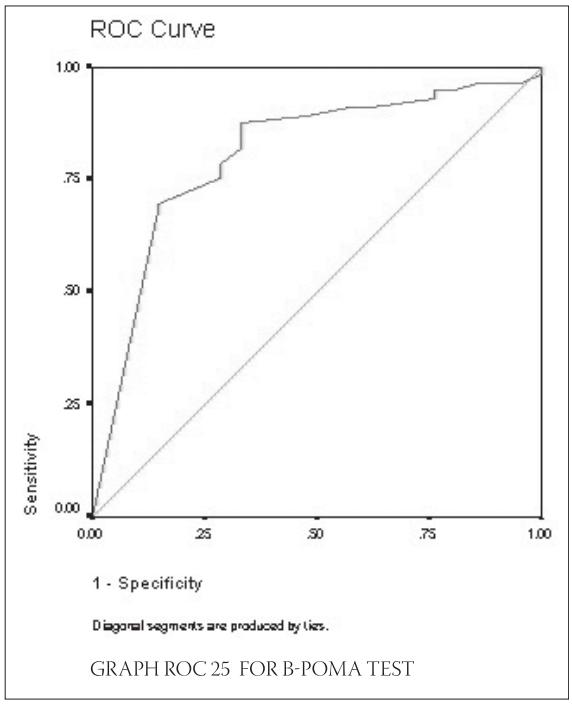
TABLE 10. Testing significance of differences in particular tests for questioned persons who fell and those who did not

TEST	B- POMA	Risk factors
B- POMA		0,189
Risk factors	0,189	

TABLE 11. Spearman's correlation coefficient between the value of B - POMA test and the risk factor score (questionnaire).

twice of more times, while the same number of questioned persons provided data for one fall only. Out of 27 men, four questioned male persons (14,81%) – one living alone, three within the community, provided data on fall. Out of 50 women, data on fall was provided by 17 questioned female persons 17 (34%) – 9 living in a community, 8 living alone. Data on fall related to gender and the way of life (alone or within a community) is provided in tables 2 – 4.

In relation to risk factor score achieved through the questionnaire and B-POMA test, there are statistically significant differences between men and women, as well as between questioned persons who fell and those who did not. On the contrary, there are no significant differences in relation to the way of living (alone or within a community) - Tables 8 - 10. There was no statistically significant difference between the value of B - POMA test and the risk factor score (questionnaire). The values of Spearman's correlation coefficient are shown in table 11. ROC graph for B-POMA test is shown on graph 2.5.



GRAPH ROC 25 FOR B-POMA TEST

Discussion

Psychophysical abilities in third age decrease, while the capability of adaptation to endogenous and exogenous burdens decreases as well. In 1987, "Harada" et al. (1) found out that 9,7 million people in USA have difficulties in conducting their daily activities, whereas 59% (5,6 million) are older than 65 in age. In 65 – 74 age group, each tenth person has this problem. In 75 – 84 age group, each fourth person suffers from the problem, whereas 3 – 5 persons of 85 years in age suffer from this problem. Every person can fall during movement, whilst the possibility of fall is much more often in persons of the third age. More frequents falls during movement in this part of population is connected to aging, that is with the existence of different chronic diseases and disablements, which are providing precondition for fall. Aging is followed by changes in neurological, muscular and bone status. Muscular atrophy is most often result of the decrease on muscular fiber rather than change in their

size, which is again closely connected with the loss of functional motoric functions. The decrease of muscular strength limits the functional capacity and contributes to the chances for fall during the third age of life. Study has encompassed 77 questioned patients of both genders, all of average age of 71,73 ± 5,63 (scope of 65 - 90), using random sampling method. Every patient has been questioned in his / her own home and was completely familiar with the methodology and aims of the questionnaire. Percentage regarding gender was: women 64,94 % (50 questioned persons), and men 35,06% (27 persons), which is in accordance with demographic data about this population group in our circumstances (7). As for other studies, gender structure differs. For example, "Harada" et al (1) state that women presented 87% questioned persons in their study group. As for the age, there was no statistically significant difference in regard of gender. As for the level of education, there is evident statistically significant difference between men and women ($p < 0,001$). As much as 56% women from the questioned group have basic education only, in relation to 7,41 % of men. Lower level of education in women belonging to the third age group can be observed within the context of social, cultural and sub-cultural circumstances of our region, where it used to be common not to educate female children that often. This was particularly specific in rural areas, where most of our questioned persons came from. Basic education was not obligatory in the time when they were supposed to go to school, which led to a very few number of those who have college, higher or graduate education. For example, 4% of women have higher or graduate education, in relation to 33,33 % of men of the questioned group. Results of this study differ from the data from documentation, mostly because not more than 29,87% questioned people live alone, while this percentage in other studies is twice or three times higher (8, 9). It is possible to explain this discrepancy by providing cultural and economical differences in the society, since it is quite usual for this region that younger generations do live with their parents, as a lack of housing facilities, which opposes such solutions. As compared to other, mostly western countries, there are no conditions, which would make it easier for third aged people to conduct an independent living. It could have been expected that the percentage of older people living alone would be lower, though war activities contributed to the fact that a large number of younger persons migrated, which then led to the fact that the number of third age persons living alone increased. A third of single-living third age persons fall at least once each year, where 1/4 suffer severe injuries, another 1/4 limiting their activities to the great extent due to fear factor (2, 3, 4). During this study, 21 questioned persons (27,27%) provided data about two or more falls, nine among them living alone (1 man and 8 women), 12 of them living within a community (3 men and 9 women). Questioned persons living on their own had higher risk factor score than those living in the community, women prevailing. As for those living in the community, the difference in gender distribution of answer to the questionnaire is not so clearly displayed. However, average values of risk factor score are not statistically and significantly different in relation to the data about the way of living. There is statistically significant difference in risk factor score in answers of questioned people who did not provide the fall data. Though many authors dedicated their surveys to the research of priority of posture (10), there is still no unified attitude. As a difference from many other studies, Shumway-Cook et al. (11) (based on their study) do not support the opinion that the posture in hierarchy is more important that so called secondary tasks. To be more specific, these authors document that there is significant decrease of postural stability prior to the decrease of cognitive performances, which is why they suggest modifications to the hypothesis of posture priority. Their opinion is that distribution of consideration during completion of concurrent tasks is very complex and dependent of many factors, primarily nature of both cognitive and postural tasks and instructions given. In other words, priority of cognitive task always occurs in situation where there is no potential or understanding danger of injury. Teasdale et al. (12), who concluded that the request for increased attention is growing up in accordance with the difficulty of the postural task to be performed, support such manner of thinking. Raîche et al.. (13) state that, according to documentation data, "cut-off" value of the Tinetti B-POMA test has never been defined. According to their results, the sensitivity of the test is 70% while the particularity of the same is 52%. In accordance to their opinion, sudden decrease of sensitivity to ROC graph shows that not even the high score during the test is no guarantee for a particular person that he or she will not fall. Authors explain such attitude by the fact that the fall is conditioned with multiple number of factors, whereas the test cannot note the influence of all these. This leads to conclusion that the test is not capable of correct identification of a person whose balance problems are not so hard. Apart from mentioned limitations, the authors consider B-POMA test to be a consisting part of periodical health examination tests for third age persons. Average results score achieved through B-POMA test in this study are statisti-

cally and significantly higher in men and questioned persons who did not provide the fall data, while there was no statistically significant difference in relation to the way of living. These results are in accordance with the documentation data (14). The performance of tasks given is not usual, while most of the questioned persons never even did such a thing. Most of the questioned persons were categorical in stating that they cannot even do that (keeping balance while turning for 360 degrees). A quite long verbal support was needed for the performance, apart from explanation. This result is in accordance with the result of "Studenski" and et al. (15) who published that older persons with recent fall experience were less stable than the controlled group of persons of similar age, during the postural test of standing on one foot only and turning around. As opposed to Di Fabio and Seay (16), statistically significant correlation with risk factor score has not been determined (r: 0,189 - 0,222). The influence of exercising in order to cut down the fall risk factor is still quite blurry. Comparison of different studies makes it harder to understand due to different therapy programmes and inconsistence in the area of defining and stating balance. After three months of programme for exercising strength and flexibility, Brown and Holoszy (17) note statistical improvement in women, but not in men older than 60 years of age. Hu and Woollacott (18) consider that the decrease of postural swinging will occur after exercises focused onto improvement of censor information organization, which are balance control. Shumway-Cooky et al. (19) concluded, based on their study results, that multidimensional programme of exercises might result in increase of balance and mobility as well as reduction of fall risk factor. Their therapeutic approach is based on the model of postural control, which suggests that stability is the result of complex interactions of muscular, bone and neurological system. Prior to defining the exercising program, it is necessary to state to what measure and what specific part of this physiological system contributes to the decrease of stability and mobility in third age persons. Aims of their therapeutic approach were prevention or improvement of existing damage, development of effective, efficient and specific sensor and motoric strategies, as well as adaptation of specific tasks within the context of their functional performance in changed conditions of their immediate environment. Buchner et al. (20) state that this is not only that exercise improves walking and balancing mechanism, but it probably increases physiologic reserve abilities is strength and aerobic capacity. According to their opinion, the fall is the stress to which the organism responds in dependence to existing physiologic reserves, which are not in use during usual daily activities. In any case, exercises do not increase the fall risk factor, which is very often a fear while considering possibilities of therapy approach to this problem. The increase of average lifetime will result in larger number of persons with disablements. It is to be expected that the needs for rehabilitation will increase, since these persons will be in a need of help in order to keep their functionality at the highest level possible. Unfortunately, today's doctors do not often recommend third age person an adequate physical treatment, that is rehabilitation services are not fully available to this population group.

Conclusion

1. 3 out of 80 persons were excluded from the study (3,75%): one person had MMSE value less than 20, another died and third had a stroke. 77 questioned persons participated in the study: 27 men (35,06%) and 50 women (64,94%). Average age was 71,23 ± 5,63 (scope of 65 to 90 years): for women 71,22 ± 5,80 (scope of 65 - 90 years) and for men 72,67 ± 5,26 (scope of 65 to 82 years).

2. As for education data, there is evident statistically significant difference between men and women ($p < 0,001$): 56% women from the questioned group only had basic education, in comparison to 7,41% of men, while 4% of women had higher or graduate education in comparison to 33,33% of men from the questioned group.

3. During the period of study conduct, 21 questioned persons (27,27%) fell two or more times, while the same number of persons provided data about one fall only. Out of 27 men, 4 questioned persons only (14,81%) provided the data about fall: one living alone, three living in the community. Out of 50 women, 17 of them (34%) provided data of fall: 9 living in the community, eight living alone.

4. In regard to the value of risk factor score achieved through the questionnaire and the B-POMA test, there are statistically significant differences between men and women ($p < 0,005$, that is $p < 0,01$), as well as with questioned persons who never fell ($p < 0,001$, that is $p < 0,01$). Concerning the way of living (alone or within a community) there were no statistically significant differences ($p > 0,05$).

5. Particularity of B-POMA test is 91,07%, while for risk factor score it is much less. Percentage of false positive results for B-POMA test is 12,93, while for risk factor score it is as much as 36,43.

6. "Cut-off" value for risk factor score used to be 8, while it was 17 with B-POMA test. Regarding the "cut-off" value, B-POMA test identified 20 out of 21 questioned persons who fell. The value for the risk factor score is 12 to 21.

7. The increase in life duration results with the increase of persons with disablements. It is to be expected that there will be more needs for the rehabilitation services, which would help such persons to keep their functionality at a highest level possible. Unfortunately, today's doctors do not often recommend third age person an adequate physical treatment, that is rehabilitation services are not fully available to this population group.

8. Methodology applied in this study proved to be efficient and simple for both use and for scientific purposes, as well as for daily practice. Adequate and timely identification of risk third age persons and their adequate treatment (physical therapy) will cut off social, medical and especially economical consequences of fall to the great extent. In this manner, independence of third age persons will improve, which is surely one of the aims in clinical geriatrics.

References

(1) Harada N., Chiu V., Damron-Rodriquez J., et al. Screening for balance and mobility impairment in elderly individuals living in residential care facilities. Phys Ther. 1995; 75(6): 462-469

(2) Tinetti M.E., Speechley M., Ginter S.F. Risk factors for falls among elderly persons living in the. N. Engl. J. Med. 1988; 319(26): 1701-1707.

(3) Tinetti M.E., Baker D.I., McAway G., at al. A multifactor intervention to reduce the risk of falling among elderly people living in the. N. Engl. J. Med. 1994; 331: 821-827.

(4) Kellogg International Work Group on the Prevention of Falls by the Elderly. Dan Med Bull. 1987; 34 (suppl.4): 31-34.

(5) Horak F. and Nashner L. Central programming of postural movements: adaptation to altered support surface configuration. J. Neurophysiol. 1986; 55(6): 1369-1381.

(6) Berg K. Balance and its measure in the elderly: a review. Physiotherapy Canada. 1989; 41: 240-246.

(7) Gavranović M. et al. Clinical geriatrics International Peace Centre. Sarajevo 1997; 13-15.

(8) Powell L.E., Myers A.M. The activities-specific balance confidence (abc) scale. J, Gerontol. 1995; 50(1)A: M28-M34.

(9) Tinetti M.E., Richman D., Powell L.E. Falls efficacy as a measure of fear of falling. J. Gerontol. 1990; 45(6): P239-P243.

(10) Stelmach G.E., Zelaznik H.N., Lower D. The influence of aging and attentional demands on recovery from postural instability. Aging 1900; 2(2): 155-161.

(11) Shumway-Cook A., Woollacott M., Kimberly A., Kimberly A., Baldwin M. The effects of two types of cognitive tasks on postural stability in older adults with and without a history of falls. J. Gerontol. Med. Sci. 1997; 4: M232-M239.

(12) Teasdale N., Stelmach G.E., Breuing A. Postural sway characteristics of elderly persons under normal and altered visual and support surface conditions. J. Gerontol. Med. Sci. 1991; 41: M197-M223.

(13) Raiche M., Hébert R., Prince F., Corriveau H. Screening older adults at risk of falling with the Tinetti balance scale. Lancet 2000; 356 (9234): 1001-1002.

(14) Tinetti M.E. Perfomance-oriented assessment of mobility problems in elderly patients. J. Am. Geriatr. Soc. 1986; 34(2): 119-126.

(15) Studenski S., Duncan P.W., Chandler J. Postural responses and effector factors in persons with unexplained falls : results and methodologic issues. J. Am. Geriatr. Soc. 1991; 39: 229-234.

(16) Di Fabio R.P., Seay R. Use of the "Fast Evaluation of Mobility, Balance and Fear" in elderly dwellers: validity and realiability. Phys Ther 1997; 77(9): 904-917.

(17) Brown M., Holloszy J.O. Effects of a low intensity exercise program on selected physical perfomance characteristics of 60- to 70-year olds. Aging 1991; 3: 129-139.

(18) Hu M.H., Woollacott M.H. Multisensory training of standing balance in older adults, II: kinematic and electromyographic postural responses. J. Gerontol. 1994; 49(2): M62-M71.

(19) Shumway-Cook A., Gruber W., Baldwin M., et al. The effect of multidimensional exercise on balance, mobility, and fall risk in -dwelling older adults. Phys. Ther. 1997; 77(1): 46-57.

(20) Buchner D.M., Cress M.E., de Lauter B.J., Esselman P.C, et al. The Effect of strength and endurance training on gait, balance, fall risk, and health services use in -living older adults. J. Gerontol. 1997; 52(24)A: M218-M224.

ANNEX

B-POMA test

TASK	USUAL	ADAPTIVE	ABNORMAL
Balance in sitting position	Good, stabile	Grabbing the chair in order to stay sitting properly	Leaning onwards, sliding in the chair
Getting up from the chair	At once, without helping hands	Helping with hands and / or moving forward in the chair prior to standing up	Succeeds after several trials, cannot do it without help aside
Keeps balance in 3 – 5 seconds after getting up	Good, without grabbing onto chair	Good, but with grabbing onto chair	Signs of instability
Balance in standing position	Good, no grabbing, feet kept closely to each other	Good, but cannot keep feet together	Any sign of instability or grabbing for help
Balance in Romberg position	Good, no grabbing for help	Good though feet apart	Any sign of instability or any sign of grabbing for help
Balance in turns for 360^0	Good, arms not swinging, no need for grabbing help; continuous steps	Steps not continuous: feet of one leg completely on the ground before the other is up	Any sign of instability or any sign of grabbing for help
Interrogator, slightly pushing the sternum (three times) pushes back the person standing with feet by feet	Balance despite of pressure	Must step out but keeps balance	Cannot keep the balance
Persons standing with feet close to each other is asked to turn the neck from one side to another and look up	Executes at least half of asked moves; can look into the ceiling without swinging arms, pain, instability of dizziness	Decreased volume of movements, no swinging arms, no instability, pain, dizziness or loss of consciousness	Any kind of instability, pain, dizziness or loss of consciousness
Keeps balance while staning one leg	5 seconds without holding onto something		Not capable of
Questioned person stands up and leaning backwards as much as possible	No need for support	Less volume of movements, need for holding onto something	Not capable of
Task of stretching or standing or fingers while trying to reach an object from a shelf	Manages without holding up, no instability manifested	Manages but with holding up to something	Not capable of or loosing balance
Lifting a pen from the floor	Manages at once, without help of hands while returning to the standing position	Manages at once though uses hands or support while returning to standing position	Cannot bend down or straighten up, or several trials are needed
Sitting	In one move, without problem ("smooth")	Hands help needed or a movement is not smooth	Falls into the chair, misjudges distance (does not sit down into the middle of the chair)