

# Functionality after hip surgery: correlation between balance, age, independence, and depression among the elderly

Marcela de Abreu Silva Couto<sup>1</sup>, Rodrigo Reiff<sup>2</sup>, Alessandra Paiva de Castro<sup>3</sup>

## ABSTRACT

**Objective:** To determine correlations between age and balance, independence, and depression among the elderly who suffered hip fractures following a fall. **Method:** The consecutive sample included elderly who had suffered hip fractures within the past 24 months. We evaluated 14 elderly patients (12 women and two men); with an average age of  $78 \pm 6.9$  years old. A questionnaire was applied to obtain general data, *Timed Up and Go* (TUG test), Berg Balance Scale (BBS), Geriatric Depression Scale - Short form (GDS-S), Barthel Index (BI), and Waist-hip ratio (WHR). We used the one-way ANOVA, *t*-test, and Pearson correlation tests with a significance levels of 5%. **Results:** Mean tests: BBS ( $35.38 \pm 33.06$ ), the TUG test ( $28.40 \pm 10.59$ ), the pre-fall GDS-S  $6.33 \pm 1.52$ , the post-fall GDS-S  $7.66 \pm 1.52$ , and the WHR  $1.05 \pm 0.35$  for men and  $0.92 \pm 0.12$  for women. The Barthel Index pre-fall was  $16.20 \pm 5.4$  and the Barthel Index post-fall was  $15.12 \pm 6.78$ . The greater the age, the longer the stay, but there was no correlation between age and function. There was a negative correlation between age and balance, but age was not related to the level of depression. **Conclusion:** A positive correlation was found between age and length of stay and a negative correlation was found between age and balance. There was a decrease in the BBS, and an increase in the length of the TUG test and WHR.

**Keywords:** accidental falls, aged, femoral fractures, hip fractures, postural balance

<sup>1</sup> Masters candidate, Programa de Pós-graduação em Fisioterapia da *Universidade Federal de São Carlos (UFSCar)* (Graduate Program in Physical Therapy at São Carlos Federal University - UFSCar).

<sup>2</sup> Orthopedic surgeon, *Santa Casa de Misericórdia de São Carlos* (São Carlos Holy House of Mercy).

<sup>3</sup> Physical therapist, Professor at the *Universidade Federal do Espírito Santo (UFES)* (Espírito Santo Federal University - UFES).

Mailing address:  
Marcela de Abreu Silva Couto  
E-mail: marcela.deabreu@yahoo.com.br

Received on September 14, 2011.  
Accepted on June 26, 2012.

DOI: 10.5935/0104-7795.20120007

## INTRODUCTION

Aging is defined as a progressive, gradual, variable, and irreversible process, characterized by morphological, physiological, biochemical, and psychological changes. Thus, the elderly become susceptible to diseases and there is limitation of functionality and independence. Functional limitations associated with acute or chronic infections may occur, making the elderly more vulnerable to environmental risks, and consequently, to falling, which is the biggest precursor factor for fractures.<sup>1-3</sup> Studies focused on public health and rehabilitation are pertinent due to the high indices of mortality and morbidity,<sup>3</sup> to the associated economic costs,<sup>2</sup> and to the difficult rehabilitation process involved in the occurrence of falls and fractures.<sup>4</sup>

Fractures are aggravating consequences and are much feared by the elderly population, and their occurrence is mainly associated with falling down on the ground, in addition to being an important risk factor for new falls. In studies about falls, 5% resulted in fractures and 5% to 10% in significant injuries that required medical care.<sup>5</sup>

Preceding studies on the consequences of hip fractures have focused on mortality rates,<sup>2,3</sup> but there are few Brazilian studies that provide data on the functional consequences of such fracture.<sup>6</sup> Considering the serious socio-economic problem that ensues from the occurrence of falls followed by fractures in the elderly, there are few studies that consider the multidisciplinary aspects or that address the conditions of these individuals in chronic periods after the surgical process. In this way, the hypothesis of this study was that age is directly related to a reduction in balance, dependence level, waist hip relationship (WHR), and depression after a hip fracture.

## OBJECTIVE

This work seeks to verify whether there is any correlation between age, balance, independence in grooming activities, depression, and time in the hospital for the elderly who suffered hip fractures after falling, in addition to showing some aspects that characterize their functionality.

## METHOD

The present study was submitted to the Ethics in Human Research Committee from the São Carlos Federal University

and was approved (protocol number 054/2011). This study is mixed, transversal, and retrospective.

A consecutive sample, composed of individuals aged 60 years or more, who had hip surgery at the *Hospital Santa Casa de Misericórdia de São Carlos* (São Carlos Holy House of Mercy) after a femoral fracture due to falling. The data was collected from three to 24 months after the surgical procedure. The individuals who presented a diagnosis of malignant neoplasm, other fractures, osteoarthritis, advanced consequences of diabetes mellitus, and serious sight limitation were excluded from the study. From among the 67 surgeries recorded at the *Santa Casa de Misericórdia de São Carlos*, in the period from January 15, 2009 through January 15, 2010, eight patients passed away - five of whom were younger than 60 years, thirteen individuals had osteoarthritis, two had a malignant neoplasm diagnosis, two did not agree to take part in the research, and twenty other individuals who could not be contacted by telephone. Thus, fourteen patients, 12 females and 2 males, with an average age of 78 years  $\pm$  6.9 were part of the study (Table 1).

The invitation to participate in the research was made by telephone. After the invitation, the evaluator paid a visit to the residence to evaluate the functional condition of the elderly residents. All the participants signed a Free and Informed Consent Form before the evaluations were made.

### Procedures

A questionnaire to obtain general information with the following items was applied: socio-economic profile, information about the fall, functionality, medication treatments, and rehabilitation.

The evaluation was composed of the Berg Balance Scale (BBS),<sup>7,8</sup> the *Timed Up and Go* test (TUG test),<sup>9</sup> and the measurements for the calculation of the waist-hip relationship were taken.<sup>10,11</sup> The Abbreviated Geriatric Depression Scale (GDS-A)<sup>12</sup> and the Barthel Index<sup>13,14</sup> were applied twice. The first application of these two instruments was made to obtain answers referring to the current condition, that is, the period since the fall. For the second collection it was asked that the

patient describe the conditions concerning the pre-fall period, that is, what was the general situation before the fall that culminated in the proximal femur fracture.

While obtaining data, it was possible to verify information related to mortality, age, gender, the period between the fall, the hospitalization, and the surgical procedure, as well as the time in the hospital, the number of falls after surgery, their functional independence, and the rehabilitation process. It was also possible to identify co-morbidities such as hypertension, diabetes mellitus, and osteoporosis.

### Statistical analysis

The data collected was statistically analyzed using the MINITAB version 14 program. A normal distribution was found throughout the data set and, thus, one-way ANOVA was applied; the *t* test was applied for parametric variables, and the Pearson correlation test was applied to verify associations between age and balance, depression, functionality, and duration of hospitalization. The significance level adopted was 5%.

## RESULTS

As for the rehabilitation process it was verified that 28.57% of the patients did not receive physiotherapy, 42.85% of the patients received an average of 15 sessions, and 14.28% of the patients received on average 24 sessions of physiotherapy after surgery. The patients who received physiotherapy sessions reported having done electrotherapy, hydrotherapy, and a conventional strengthening program for lower limbs and trunk. Among the individuals evaluated, only 14.28% had been treated by a physiotherapist at the time of the evaluation and 28.57% had received physiotherapy sessions before their fall.

For the BBS, 50% of the evaluated individuals showed scoring lower than 45. According to the Barthel Index post-fall, 64.28% of the patients were dependent on care-givers to perform daily life activities, and among those, only 22.22% were doing physiotherapy during the evaluation period (Table 2). There was a significant difference found between the pre and post-fall periods.

**Table 1.** Characteristics of the subjects

N	Gender (M/F)	Average age (years)	Period of hospitalization (days)	Period between post-surgery and evaluation date (days)	Time bed-ridden (days after surgery)
14	2/12	78 $\pm$ 6.9	5.71 $\pm$ 2.78	332.52 $\pm$ 84.44	24.83 $\pm$ 3.53

**Table 2.** Tests Results

Tests	Scores Average
BBS	35.38 ± 33.06
TUG test	28.40 ± 10.59
GDS-A pre-fall	6.33 ± 1.52
GDS-A post-fall	7.66 ± 1.52
Barthel Index pre-fall	16.20 ± 5.4
Barthel Index post-fall	15.12 ± 6.78

BBS: Berg Balance Scale; TUG: *Timed Up and Go* test; GDS-A: Geriatric Depression Scale Abbreviated

The calculation of the waist-hip relationship showed an average of  $1.05 \pm 0.35$  for men and  $0.92 \pm 0.12$  for women. Among the elderly evaluated, 14.28% had Type 2 Diabetes mellitus, 35.71% had osteoporosis, and 71.42% had hypertension controlled by medication.

According to the general information questionnaire, 78.57% of the patients reported fear of a new fall, 21.42% reported fear of going downstairs, 14.28% reported fear of slipping, 28.57% reported fear of going out in the street, 14.28% reported fear of driving, and 28.57% reported fear of taking a shower.

As for the correlations, it was observed that the greater the age, the greater the period of hospitalization (Table 3). There was no correlation between age and function. In addition, there was a negative correlation between age and balance. In the same way, age was not correlated to the level of depression (Table 3).

## DISCUSSION

Considering that a score on the Berg Balance Scale (BBS) lower than 45 indicates a higher risk of falling,<sup>7,15</sup> 50% of the evaluated individuals in the present study showed that risk. The difference between the pre and post-fracture periods was not significant, but there was a tendency to increase dependence, which can be explained by the low

adherence to rehabilitation programs after their hip surgery. Sylliaas et al.<sup>15</sup> showed the importance of muscular strengthening exercises for the prevention of balance deficiency. They identified an increase in the Berg Scale average scoring, improvement in the deambulation capacity, and more gait confidence after training to strengthen the lower limbs in patients who had had hip surgery. According to those authors, these results can also be interpreted as an increase in the functional performance.

On the interpretation of the TUG test results in individuals who had had hip surgery, the study by Kristensen et al.<sup>16</sup> demonstrates that a score higher than 24 predicts the risk of falling for individuals. In the present study 42.85% of the patients had a score lower than 24 points and, among these, 71.42% had falls. The number of falls after surgery varied between one and 10. However, among the 57.14% who had a score higher than 24 points, 66.66% had falls. In Denmark, the TUG test cut point of 30 seconds was recommended as an indicator of quality to evaluate the treatment of people with hip fractures.<sup>16</sup> The TUG average score in our study was  $32.23 \pm 4.94\%$ , that is, higher than the minimum score as indicated above; therefore, these patients are within the risk group for new falls.

In the present study, the results from the Barthel Index show that 64.28% of the individuals are dependent on caregivers to perform daily life activities, and among those only 14.28% participated in a rehabilitation program at the time of the evaluation. Moreover, the Barthel Index average indicates a score equivalent to moderate independence, which is to say they need some help in their grooming activities.<sup>13,14</sup> In a cohort study in which 1,667 elderly aged between 75 and 84 years were evaluated, the authors verified that the dependent elderly had 14 times the probability of falling than those the same age who were independent. Of all the falls, 5%

result in fractures and 5 to 10% in serious injuries that need medical care.<sup>5</sup>

Hip fractures cause a significant impact on the functional capacity and in social independence.<sup>17</sup> A prospective study by Stewart et al.<sup>18</sup> verified that patients over 50 showed diminished mobility and increased risk of a new fall after hip surgery. The results of the present study did not reveal any correlation between age and the level of functionality for gait and balance. Among those individuals evaluated in the present study, 64.28% of the patients had falls after hip surgery. The individuals evaluated reported fear of falling again, fear of going downstairs, fear of slipping, fear of taking a shower, fear of going out in the street, and fear of driving. Considering this, regardless of age, it is necessary to include elderly patients who had hip surgery in a fall prevention program that must be initiated at the orthopedic infirmary or rehabilitation unit and continued after they receive their clean bill of health, in consonance with what is suggested by Lin et al.<sup>19</sup>

In addition to peculiarities in the fall prevention and rehabilitation programs after hip fractures, the depression factor must be considered. Its impact on the functional recovery of patients after a hip fracture has been repeatedly evaluated by physiotherapists and orthopedic researchers, but the findings are conflicting.<sup>20</sup> Although some studies report that the depressive symptoms may complicate the course of rehabilitation<sup>21</sup> and affect functional performance,<sup>22</sup> others could not find any significant association.<sup>23-25</sup> The findings of our study indicate that the elderly did not show significant differences in relation to depression when compared to the pre and post-hip fracture GDS-A readings.<sup>12</sup>

Morghen et al.<sup>20</sup> proposed to evaluate the influence of depression on the elderly with fractures who were having physiotherapy sessions six times a week. They found that there were no differences in the period of hospitalization and in the time spent in rehabilitation in accordance with the gravity of the depressive symptoms. The results of our study did not reveal any correlation between depression and age, in addition to not correlating depression as a factor that influences the post-fracture functional condition.

From those evaluated by Morghen et al.<sup>20</sup> 68,6% had an independent gait when they were released from the hospital. The patients who did not recover gait independence when they were released from the hospital

**Table 3.** The Pearson Correlation between age and balance variables, and between age and period of hospitalization

Variables	Correlation Coefficient	Value of p
Age and BBS	-0.556	0.048
Age and period of hospitalization	0.643	0.013
Age and GDS-A	0.272	0.347
Age and TUG test	0.362	0.248
Age and Barthel Index pre-fall	0.318	0.267
Age and Barthel Index post-fall	0.261	0.367

BBS: Berg Balance Scale; GDS-A: Geriatric Depression Scale Abbreviated; TUG: *Timed Up and Go* test

were older, would no longer have the chance to live alone, and were more gait dependent than before the fracture, with more cognitive impairment and more frequent symptoms of depression, even with the mix of therapy and antidepressant medication. Among those evaluated in this study, no individual was fully ambulatory at the moment of their hospital release. The average time between the date of surgery and the beginning of deambulation, that is, the bed-ridden period was  $24.83 \pm 3.53$  days. This can be considered a prolonged period of immobility, which can be the reason for musculoskeletal changes, as well as for a loss of strength, muscular atrophy,<sup>26,27</sup> an increase of intramuscular adipose tissue,<sup>28</sup> a decrease in functional capacity,<sup>19</sup> and a dependence for grooming,<sup>26</sup> constituting a frailty that can be characterized as an immobility syndrome. This long period of restriction could be explained by the non-adhesion to physiotherapy, and it can also be explained by the lack of access to appropriate rehabilitation. In the absence of surgical complications or other pathologies, the time bed-ridden, according to Kristensen et al.<sup>16</sup> is less than 10 days after hip surgery.

Excess body weight is an important factor that makes the rehabilitation process difficult. The waist-hip measurement readings identify an excess of abdominal fat.<sup>10,11</sup> In the present study it was possible to identify elevated readings in the sample when compared to the levels established in the literature. With increasing abdominal circumference there is a shift in the center of mass that alters the balance of individuals in their daily life activities for both genders. According to Almeida et al.<sup>29</sup> the values of the abdominal circumference are larger in falling women than in non-falling women. Aside from this investigation having identified the occurrence of falls, there is another important aspect that must be considered, and it concerns the high risk of cardiovascular diseases related to the abdominal circumference increase.<sup>29,30</sup> In the present study, 74% of the participants were being treated with anti-hypertension medication.

A limitation of our study was the reduced size of the sample, shown in Figure 1. An important observation is that the TUG test was quantified by the score of only one timed trial, while Kristensen et al.<sup>31</sup> recommends that the best score of three timed trials be quantified. It would be interesting if future studies considered this measurement. Considering the occurrence of falls,

the impairment of balance, and the low adhesion to the physiotherapy programs identified in this study, we can say that interventions must be proposed in order to prevent new falls. It is important to facilitate the access to a multidisciplinary staff for the rehabilitation process of people who presented post-fall fractures. Studies that investigate the adhesion and the access of these patients to rehabilitation programs after fracture surgery are necessary.

## CONCLUSION

The results of this study allowed us to conclude that age is not related to the decrease in functionality and to the increase in risk of falls for this population. There is a negative correlation between age and balance. Age is not related to their depression level. Among these factors are longer times in the TUG test, a lower score for the Berg Scale, and WHR (waist-hip relationship) above what is recommended. The greater the age, the longer the period of hospitalization, and there is no correlation between age and functionality in patients after fractures due to falling.

## REFERENCES

1. Kannegaard PN, van der Mark S, Eiken P, Abrahamson B. Excess mortality in men compared with women following a hip fracture. National analysis of comorbidities, comorbidity and survival. *Age Ageing*. 2010;39(2):203-9.
2. Giverson IM. Time trends of mortality after first hip fractures. *Osteoporos Int*. 2007;18(6):721-32.
3. Braithwaite RS, Col NF, Wong JB. Estimating hip fracture morbidity, mortality and costs. *J Am Geriatr Soc*. 2003;51(3):364-70.
4. Roche JJ, Wenn RT, Sahota O, Moran CG. Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: prospective observational cohort study. *BMJ*. 2005;331(7529):1374.
5. Perracini MR, Ramos LR. Fall-related factors in a cohort of elderly community residents. *Rev Saude Publica*. 2002;36(6):709-16.
6. Muniz CF, Arnaut AC, Yoshida M, Trelha CS. Caracterização dos idosos com fratura de fêmur proximal atendidos em hospital escola público. *Esp Saúde*. 2007;8(2):33-8.
7. Berg K, Wood-Dauphinee S, Williams JI. The Balance Scale: reliability assessment with elderly residents and patients with an acute stroke. *Scand J Rehabil Med*. 1995;27(1):27-36.
8. Miyamoto ST, Lombardi Junior I, Berg KO, Ramos LR, Natour J. Brazilian version of the Berg balance scale. *Braz J Med Biol Res*. 2004;37(9):1411-21.
9. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc*. 1991;39(2):142-8.
10. Selby JV, Friedman GD, Quesenberry CP Jr. Precursors of essential hypertension. The role of body fat distribution pattern. *Am J Epidemiol*. 1989;129(1):43-53.
11. World Health Organization. Obesity: preventing and managing the global epidemic: report of a WHO consultation. Geneva: WHO; 2000.
12. Cruice M, Worrall L, Hickson L. Reporting on psychological well-being of older adults with chronic aphasia in the context of unaffected peers. *Disabil Rehabil*. 2011;33(3):219-28.
13. Mahoney FI, Barthel DW. Functional evaluation: the Barthel Index. *Md State Med J*. 1965;14:61-5.

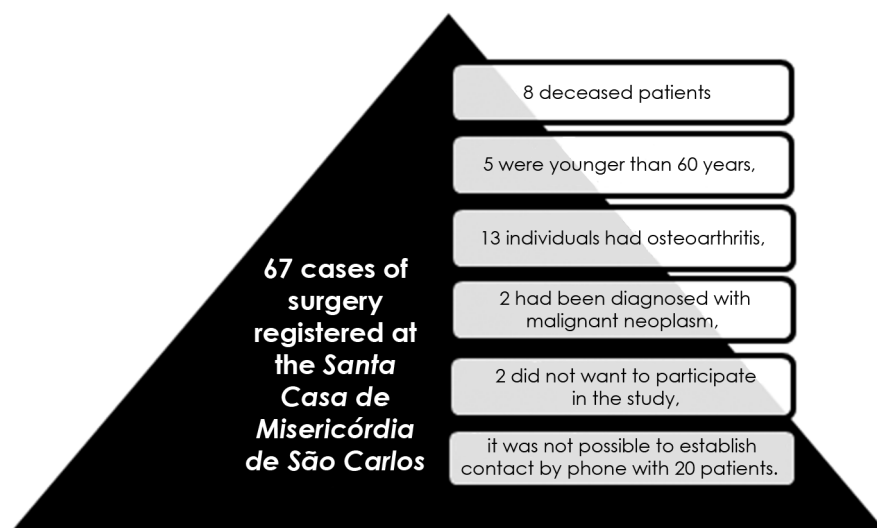


Figure 1. Sample flowchart

- 
14. Paixão CM Jr, Reichenheim ME. A review of functional status evaluation instruments in the elderly. *Cad Saude Publica*. 2005;21(1):7-19.
  15. Sylliaas H, Brovold T, Wyller TB, Bergland A. Progressive strength training in older patients after hip fracture: a randomised controlled trial. *Age Ageing*. 2011;40(2):221-7.
  16. Kristensen MT, Foss NB, Kehlet H. Timed "up & go" test as a predictor of falls within 6 months after hip fracture surgery. *Phys Ther*. 2007;87(1):24-30.
  17. Pearse EO, Redfern DJ, Sinha M, Edge AJ. Outcome following a second hip fracture. *Injury*. 2003;34(7):518-21.
  18. Stewart A, Walker LG, Porter RW, Reid DM, Primrose WR. Predicting a second hip fracture. *J Clin Densitom*. 1999;2(4):363-70.
  19. Lin PC, Chang SY. Functional recovery among elderly people one year after hip fracture surgery. *J Nurs Res*. 2004;12(1):72-82.
  20. Morghen S, Bellelli G, Manuele S, Guerini F, Frisoni GB, Trabucchi M. Moderate to severe depressive symptoms and rehabilitation outcome in older adults with hip fracture. *Int J Geriatr Psychiatry*. 2011;26:1136-43.
  21. Cullum S, Metcalfe C, Todd C, Brayne C. Does depression predict adverse outcomes for older medical inpatients? A prospective cohort study of individuals screened for a trial. *Age Ageing*. 2008;37(6):690-5.
  22. Hershkovitz A, Kalandariov Z, Hermush V, Weiss R, Brill S. Factors affecting short-term rehabilitation outcomes of disabled elderly patients with proximal hip fracture. *Arch Phys Med Rehabil*. 2007;88(7):916-21.
  23. Lieberman D, Friger M, Lieberman D. Inpatient rehabilitation outcome after hip fracture surgery in elderly patients: a prospective cohort study of 946 patients. *Arch Phys Med Rehabil*. 2006;87(2):167-71.
  24. Lenze EJ, Munin MC, Dew MA, Rogers JC, Seligman K, Mulsant BH, et al. Adverse effects of depression and cognitive impairment on rehabilitation participation and recovery from hip fracture. *Int J Geriatr Psychiatry*. 2004;19(5):472-8.
  25. Arinzon Z, Shabat S, Peisakh A, Gepstein R, Berner YN. Gender differences influence the outcome of geriatric rehabilitation following hip fracture. *Arch Gerontol Geriatr*. 2010;50(1):86-91.
  26. Di Monaco M, Vallero F, Di Monaco R, Tappero R, Cavanna A. Muscle mass and functional recovery in women with hip fracture. *Am J Phys Med Rehabil*. 2006;85(3):209-15.
  27. Ogawa H, Oshita H, Ishimaru D, Yamada K, Shimizu T, Koyama Y, et al. Analysis of muscle atrophy after hip fracture in the elderly. *Arch Phys Med Rehabil*. 2008;89(2):329-32.
  28. Di Monaco M, Vallero F, Di Monaco R, Tappero R, Cavanna A. Fat mass and skeletal muscle mass in hip-fracture women: a cross-sectional study. *Maturitas*. 2007;56(4):404-10.
  29. Almeida CW, Castro CH, Pedreira PG, Heymann RE, Szejnfeld VL. Percentage height of center of mass is associated with the risk of falls among elderly women: a case-control study. *Gait Posture*. 2011;34(2):208-12.
  30. Lean ME, Han TS, Morrison CE. Waist circumference as a measure for indicating need for weight management. *BMJ*. 1995;311(6998):158-61.
  31. Kristensen MT, Ekdahl C, Kehlet H, Bandholm T. How many trials are needed to achieve performance stability of the Timed Up & Go test in patients with hip fracture? *Arch Phys Med Rehabil*. 2010;91(6):885-9.