

# Predictive Factors of Dependency in Activities of Daily Living Following Limb Trauma in the Elderly

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## Abstract

**Background:** Traumatic injuries in the elderly often lead to permanent disabilities and long-term treatments that can adversely influence their activities of daily living (ADL). The effect on ADL is an important outcome in elderly trauma.

**Objectives:** The present study was designed to evaluate the predictive factors of dependency in ADL following limb trauma in elderly referred to Shahid Beheshti Hospital, Kashan, Iran, in 2013.

**Patients and Methods:** This descriptive study was conducted on 200 traumatic patients admitted to the trauma emergency ward of Shahid Beheshti hospital in 2013. The questionnaire used in this study had three parts: demographic data, information related to trauma, and an independence scale of ADL (ISADL). The ISADL was completed in the emergency ward to declare pre-traumatic status; it was also completed one and three months after trauma. Statistical analysis was conducted by the t-test and analysis of variance (ANOVA). The repeated measure was used to study the trend of the ISADL and other demographic variables. The multiple regression analysis was also used to declare the predictive variables related to the ISADL.

**Results:** The study population consisted of 81 males (40.5%) and 119 females (59.5%). The participants' average age was  $70.57 \pm 9.05$  years. In total, 80.5% of the elderly were completely independent in ADL before trauma; this decreased to 13.5% one month after trauma. The repeated measure analysis showed a significant improvement in the ISADL three months after trauma. Gender, age, and education had significant interaction with the ISADL. The multiple regression analysis showed that type of trauma and location of injured organ had predictive values related to the ISADL, one and three months after trauma. The place and cause of trauma, and having surgery showed a significant relationship with the ISADL three months after trauma.

**Conclusions:** Many factors, such as gender, age, education, type of trauma, and location of injured organ, may predict ADL following limb trauma.

**Keywords:** Trauma, Elderly, Activities of Daily Living

## 1. Background

Trauma is a problem for public health all over the world (1, 2). In elderly, it is often more devastating and can lead to permanent disabilities and the need for long-term treatments (3). A sharp rise in trauma and fractures has been witnessed in the aging population (4), and the outcomes of trauma in elderly are worse than those in younger patients (5). The mechanism of injury is different in elderly. Falls, accidents, occupational injuries, burns, and violence are common reasons for trauma in this age group (6).

Falling is the most common cause of injuries in the elderly population (7). One-third of people aged 65 years and above fall every year, and 1% to 5% of these falls result in fractures. The prevalence of trauma is affected by

age, gender, and a few other factors (4, 8, 9). Specifically, poor housing, social isolation, low income, reduced functional capacity, and dependency on others are factors that can increase the risk of injury in elderly (6). Home safety measures (poor lighting, loose rugs, etc.); physiological changes, such as decreased bone mass (10); chronic diseases, such as Parkinson's disease, cardiovascular diseases and arthritis; depression; cognitive impairment; drug-induced side effects; physical fitness; and age higher than 80 years are other factors that can influence trauma in elderly (11). At least 40% of falls are associated with medical factors (6).

Most injuries in elderly happen in the limbs (9, 12). Injuries to the upper limbs are often seen in mobile patients. The most common lower limb injury is femoral neck fracture, for which the death rate is 10% to 40% at 6 months (6).

Currently, most research studies focus on initial stabilization and inpatient hospitalization, without examining functional recovery after discharge (3). Activities of daily living (ADL) are important indicators of geriatric health. ADL provide useful information for proper planning in the field of elderly care (13). Between 20% and 30% of elderly will eventually be stricken by disability, the loss of independence in ADL, early residence in elderly nursing centers, or even death following fall-related injuries (7).

Limited studies exist regarding ADL following trauma in elderly. Inaba et al. in Canada found that 20% of elderly required home care or institutional nursing care following trauma, and 63% of elderly were living independently three years after trauma (14). Meanwhile, Karbakhsh reported that 50% of elderly had some degree of disability three months after trauma in Iran (8). In the study by Sipila et al. (2011), only 20% of elderly recovered to pre-fracture level in mobility one year after hip fracture (15). In the study of Alavi et al. (2014), only 22.5% of elderly were completely independent three months after trauma (16). Previous studies have shown the different levels of ADL after trauma in elderly (3, 17).

Several factors that can affect ADL after trauma in elderly might be related to the cultures and health-related systems of different countries. Although trauma and its complications are recognized as a public health problem throughout the world, the literature currently relies on data that are overwhelmingly from the United States and Europe, while the situation in non-Western populations is poorly understood. The lack of such information on health trends can inhibit accurate predictions for future health care needs in this age group. Therefore, it is necessary to obtain correct and up-to-date data to plan health services for the elderly (18). Understanding the predictive factors of dependency after trauma can be helpful for realistic planning and employing appropriate strategies in rehabilitation programs. The current knowledge in this field is limited in Iran.

## 2. Objectives

The aim of this study was to evaluate the predictive factors of dependency in ADL following limb trauma in the elderly referred to Shahid Beheshti hospital in Kashan, Iran (2013).

## 3. Patients and Methods

**Study design:** This descriptive study was conducted in the fall and winter of 2013 in the trauma emergency ward of Shahid Beheshti hospital in Kashan, Iran.

**Subjects:** The sampling population included elderly with limb trauma who were referred to the emergency ward. The sample size was calculated based on the Cochran's formula with a type I error of 0.05, sampling error of 0.06, and an estimated prevalence of limb trauma of 0.12 (19). Then, 162 samples were estimated to be needed; however, 200 subjects entered the study sequentially to compensate for possible attrition.

The inclusion criteria were age over 60 years, no history of dementia, ability to respond to questionnaires, and independence in ADL prior to injury. The exclusion criterion was refusal of subjects to continue the study. All of the subjects who asked to participate in the study accepted the request. Eight patients later died in the follow-up, so a total of 192 patients completed the study.

**Measurement:** The questionnaire used in this study had three parts. The first part of the questionnaire included questions regarding demographic information (age, sex, education level, marital status, occupation, place of residence, and socioeconomic status). The second part included information related to trauma (time of trauma, place of trauma, cause of trauma, type of trauma, location of injured organ, and history of chronic diseases). The variables in these parts were considered the predictive factors of dependency in ADL after trauma. The content validity of the first and second parts of the questionnaires was approved by the experts in geriatric nursing; the test-retest reliability of these parts was 0.95. The third part was an independence scale of activities of daily living (ISADL) that was used to evaluate independence in ADL before and after traumatic injury (13). The ISADL had 20 questions about ADL, such as bathing, preserving personal hygiene, shopping, managing finances, transporting, climbing stairs, walking, cleaning, dressing, using the telephone, washing and ironing clothes, preparing meals, eating and drinking, controlling urination and defecation, taking medications, getting up from a chair, going to a bed and getting up from the bed, and sorting and preparing the bed.

Every item received the scores of 1 - 4 (1 = completely dependent, 2 = the relatively dependent, 3 = the relatively independent, and 4 = completely independent). The range of scores was 20 - 80. Elderly with scores of 60 - 80, 40 - 60, and 20 - 60 were considered independent, relatively independent, and relatively dependent, respectively. A score of 20 were considered completely dependent. In the study of Yaghmai (2005), the content validity of the ISADL questionnaire was confirmed by 10 nursing instructors (13). The reliability of the questionnaire was set at 0.98 by Cronbach's alpha.

The questionnaire was completed in the emergency department to show the ADL one week before injury. The second author interviewed all of the patients who had the in-

clusion criteria in the emergency department during the morning and evening shifts. The telephone numbers and addresses of the patients were recorded in the questionnaires. Then, the patients were followed, and the questionnaire was completed one and three months after trauma. The patients were telephoned by the second author, and the questionnaires were completed through telephone interviews in the morning or evening hours and at the homes or workplaces of patients according to their preferences.

### 3.1. Statistical Analysis

Statistical analysis was conducted using SPSS software, version 16. Data normality was determined by the Kolmogorov-Smirnov Test. One-way ANOVA was used to show the difference between ISADL scores in different time intervals. The independent sample t-test and ANOVA test showed a relationship between ISADL scores and different variables. The repeated measure was used to study the trend of the ISADL and other demographic variables. The multiple regression analysis showed predictive variables related to the ISADL. The significance level was set at ( $P < 0.05$ ) in all tests.

**Ethical consideration:** This study was approved by the research council of the faculty of nursing and midwifery, and its ethical aspects were approved by the research ethics committee at the Kashan University of Medical Sciences.

## 4. Results

The study population consisted of 81 males (40.5%) and 119 females (59.5%). The participants' average age was  $70.57 \pm 9.05$  years. A total of 118 (59%) of the participants were married, and 82 (41%) were widowed. In 52.5% of the patients, trauma happened at home. A total of 32% of the participants lived alone. The cause of trauma in 74% of the participants was falling. A total of 80.5% of trauma led to fractures. Regarding education status, 67% were uneducated, 27% were below the diploma level, and 6% were at the level of diploma and higher. For occupation status, 17% were retired, 57% were housekeepers, 15.5% were farmers, and 10.5% had other jobs. A total of 92% of seniors reported histories of chronic diseases; 68.5% had more than one disease (diabetes 31.5%, hypertension 38%, cardiovascular disease 26.5%, kidney disease 12%, poor eyesight 50%, poor hearing 34.5%, arthritis 43%, psychological disease 13.5%, and osteoporosis 37%). Internal fixation was the most common treatment. Most of the injuries occurred at 8 AM. The other characteristics of the patients can be seen in [Table 1](#).

Before the trauma, 80.5% of the participants were completely and 17% were relatively independent. One month

**Table 1.** Characteristics of Elderly Trauma

| Demographic Data in Elderly       | No. (%)   |
|-----------------------------------|-----------|
| <b>Place of residence</b>         |           |
| City                              | 160 (80)  |
| Village                           | 40 (20)   |
| <b>History of chronic disease</b> |           |
| Yes                               | 184 (92)  |
| No                                | 16 (8)    |
| <b>History of smoking</b>         |           |
| Yes                               | 38 (19)   |
| No                                | 162 (81)  |
| <b>Access to hospital</b>         |           |
| 115 service                       | 114 (57)  |
| Private vehicle                   | 86 (43)   |
| <b>History of chronic disease</b> |           |
| Yes                               | 80 (40)   |
| No                                | 120 (60)  |
| <b>Socioeconomic status</b>       |           |
| High                              | 29 (14.5) |
| Moderate                          | 112 (56)  |
| Low                               | 59 (29.5) |
| <b>Location of injured organ</b>  |           |
| Upper limb                        | 41 (20.5) |
| Hip                               | 70 (35)   |
| Femur                             | 58 (29)   |
| Other lower-limb trauma           | 31 (15.5) |

after trauma, 13.5% of the participants were completely independent, 25% were relatively independent, 58% were relatively dependent, and 3.5% were completely dependent. Three months after trauma, 22.5% of the participants were completely independent, 45.5% were relatively independent, 26.5% were relatively dependent, and 5.5% were completely dependent. A significant reduction in ISADL scores one month after trauma that improved after three months was seen. The other data on the ISADL can be seen in [Table 2](#).

The t-test showed no significant relationship between ISADL scores (before, one month after, and three months after trauma) and place of residence and socioeconomic status. The ANOVA test showed a significant relationship between ISADL scores (before, one month after, and three months after trauma) and age, where ISADL scores were significantly higher in 60- to 67-year-old patients compared to other age groups according to Tukey's test. The re-

**Table 2.** The Scores of ISADL in Elderly Before, One Month After, and Three Months After Trauma

| The Scores of ISADL Period of Time | The Min Score | The Max Score | Mean $\pm$ SD     | P Value |
|------------------------------------|---------------|---------------|-------------------|---------|
| Before trauma                      | 32            | 80            | 70.22 $\pm$ 12.35 | 0.0001  |
| 1 month after trauma               | 0             | 75            | 41.25 $\pm$ 13.44 | 0.0001  |
| 3 months after trauma              | 0             | 80            | 48.81 $\pm$ 17.66 | 0.0001  |

relationship between ISADL scores and different variables is shown in [Table 3](#).

**Table 3.** The Relationship Between the Scores of ISADL (Before, One Month After, and Three Months After Trauma) and Different Variables

| Variables                         | Period of time    |                      |                       |
|-----------------------------------|-------------------|----------------------|-----------------------|
|                                   | Before Trauma     | 1 Month After Trauma | 3 Months After Trauma |
| <b>Gender</b>                     |                   |                      |                       |
| Female                            | 68.39 $\pm$ 11.34 | 41.76 $\pm$ 10.79    | 49.09 $\pm$ 15.24     |
| Male                              | 72.91 $\pm$ 13.32 | 40.49 $\pm$ 16.62    | 48.40 $\pm$ 20.80     |
| P (t-test)                        | 0.01              | 0.54                 | 0.80                  |
| <b>Age</b>                        |                   |                      |                       |
| 60 - 67                           | 77.38 $\pm$ 5.54  | 47.87 $\pm$ 13.79    | 58.96 $\pm$ 14.32     |
| 68 - 75                           | 64.72 $\pm$ 14.49 | 35.85 $\pm$ 10.39    | 40.81 $\pm$ 15.75     |
| Over 76                           | 62.36 $\pm$ 11.64 | 34.32 $\pm$ 8.96     | 37.89 $\pm$ 14.39     |
| P (ANOVA test)                    | 0.001             | 0.001                | 0.001                 |
| <b>History of chronic disease</b> |                   |                      |                       |
| Yes                               | 69.77 $\pm$ 12.62 | 40.58 $\pm$ 13.32    | 48.12 $\pm$ 17.87     |
| No                                | 75.43 $\pm$ 7.08  | 48.93 $\pm$ 12.73    | 56.75 $\pm$ 13.02     |
| P (t-test)                        | 0.009             | 0.02                 | 0.02                  |
| <b>Education</b>                  |                   |                      |                       |
| Uneducated                        | 68.31 $\pm$ 12.47 | 38.29 $\pm$ 9.66     | 45.19 $\pm$ 14.26     |
| Below diploma                     | 73.23 $\pm$ 11.95 | 44.66 $\pm$ 16.52    | 54.76 $\pm$ 18.45     |
| Diploma and higher                | 79.00 $\pm$ 2.10  | 61.80 $\pm$ 16.54    | 64.00 $\pm$ 33.73     |
| P (ANOVA test)                    | 0.003             | 0.001                | 0.001                 |

The repeated measure analysis showed a significant improvement in the ISADL three months after trauma. Gender, age, and education had a significant interaction with the ISADL ([Table 4](#)). The multiple regression analysis showed a relationship between type of trauma and loca-

tion of injured organ, and the ISADL one and three months after trauma. The place and cause of trauma, and having surgery showed a significant relationship with the ISADL three months after trauma ([Table 5](#)).

Also, 4% of the elderly died three months after trauma.

## 5. Discussion

The results of the present study showed a significant reduction in ISADL scores one month after trauma that improved somewhat after three months. This finding is consistent with the results of Karbakhsh et al. (2006) in Tehran (8). Kelley-Quon et al. also (2010) reported that ISADL scores declined 12 months after trauma (3). One of the main goals of the nursing care of elderly after trauma is making patients get out of bed as soon as possible in order to reduce the effects of immobilization; it seems that this aim has been neglected, maybe because of the assumption that the loss of independence in elderly after trauma is natural. It is recommended that patients return to their essential activities as soon as possible to improve treatment outcomes and to reduce the complications of trauma. Patients and their families should receive education programs on this issue.

The prevalence of trauma and the recovery of posttraumatic injury are affected by age, gender, living alone, and other factors (4, 8, 9). The results of the present study showed that men had higher ISADL scores before trauma, but no significant differences were found between gender and the ISADL one and three months after trauma. Some studies showed that gender can influence recovery after trauma (4, 8, 9), although our results do not support this conclusion. Hosseinian et al. (2013) reported that men receive more support in Bandar Abbas, Iran (20). Men are traditionally responsible for duties outside of the home in Iran. Thus, men are better at activities such as the use of public transport, moving out of the house, or payment of the bills, and this might explain the higher ISADL scores before trauma in men. Gonzalez et al. (2014) (21) and Gill et al. (2013) reported that post-traumatic disability in women was greater than that in men (17), which is inconsistent with our results.

**Table 4.** Repeated Measure of ISADL in Elderly and Other Variables

| Variable                                | MS      | df | F     | P Value |
|---|---------|----|-------|---------|
| ISADL                                   | 40470.8 | 2  | 428.1 | 0.0001  |
| Lifestyle <sup>a</sup> × ISADL          | 79.5    | 2  | 0.843 | 0.431   |
| Marital status <sup>b</sup> × ISADL     | 140.64  | 4  | 1.5   | 0.2     |
| Gender <sup>c</sup> × ISADL             | 489.4   | 2  | 5.3   | 0.005   |
| Age <sup>d</sup> × ISADL                | 340.1   | 4  | 3.7   | 0.006   |
| History of disease <sup>e</sup> × ISADL | 39.4    | 2  | 0.41  | 0.66    |
| Education <sup>f</sup> × ISADL          | 229.37  | 4  | 2.48  | 0.044   |

<sup>a</sup>(Alone - with others).<sup>b</sup>(Married-widowed).<sup>c</sup>(Female-male).<sup>d</sup>(60 - 67, 68 - 75, over 75).<sup>e</sup>(Yes - no).<sup>f</sup>(Uneducated - below diploma - diploma and higher).**Table 5.** Multiple Regression Analysis of Relationship Between Variables Related to Injury With ISADL One and Three Months After Trauma

| Dependent Variable   | P Value | T      | Beta   | Adjusted R <sup>2</sup> | R <sup>2</sup> |
|--|---------|--------|--------|-------------------------|----------------|
| <b>Level of Independence in ADL 1 Month After Trauma</b>                       |         |        |        |                         |                |
| <b>Independent variable</b>  |         |        |        | 0.209                   | 0.193          |
| Cause of trauma (fall - accident)  | 0.001   | 3.23   | 0.210  |                         |                |
| Type of trauma (fracture - other types, such as dislocation, contusion, etc.)  | 0.0001  | 3.813  | 0.254  |                         |                |
| Having surgery (yes - no)  | 0.011   | -2.580 | -0.164 |                         |                |
| Location of injured organ  | 0.002   | -3.09  | 0.206- |                         |                |
| <b>Level of Independence in ADL 3 Months After Trauma</b>                      |         |        |        |                         |                |
| <b>Independent variable</b>  |         |        |        | 0.168                   | 0.155          |
| Type of trauma (fracture - other types, such as dislocation, contusion, etc.)  | 0.001   | 3.29   | 0.227  |                         |                |
| Place of trauma (home - out of home)   | 0.001   | 3.355  | 0.226  |                         |                |
| Location of injured organ (upper limb - hip - femur - other lower-limb trauma) | 0.007   | -2.714 | 0.165- |                         |                |

The present study showed that the risk of dependence due to trauma increases with age. This finding is consistent with the results of Yu et al. (2014) in Korea (22). The risk of many problems, such as musculoskeletal disorders as well as visual and hearing impairment, increases with age (23). Also, a possibility exists that older seniors limit their activities after trauma due to the fear of re-injury, and this results in lower ISADL scores in this population compared to younger patients.

A significant relationship was found between ISADL scores (before, one month after, and three months after trauma) and education. Uneducated seniors had lower ISADL scores. This finding is consistent with the study of Moeini et al. (24). Elderly with higher education levels probably have a wider range of abilities and life skills and participate more in health care activities compared to un-

educated seniors. These capabilities help them to regain independence after trauma.

The results of the present study showed that elderly with histories of chronic diseases had lower ISADL scores before, one month after, and three months after trauma, although this was not significant in the repeated measure analysis. In this study, 92% of the participants reported histories of chronic diseases, such as hypertension, diabetes, and heart disease. In the study by Hoi le et al. (2011), two-fifths of elderly suffered from at least one chronic disease (25). Underlying diseases, such as infection, orthostatic hypotension, cardiac arrhythmias, or visual and hearing impairments, make elderly susceptible to trauma, especially falls. In Brand et al.'s (2005) study, about half of rheumatic disease patients had histories of falls during the previous year (26). In the present study, most of the injuries oc-



curred at 8 AM. Most participants believed that the main causes of injuries in the morning were dizziness and imbalance. This can be the result of a sudden rising up from bed, postural hypotension, or the side effects of drugs. Training the elderly on getting up slowly from a bed, especially in the morning hours, and sitting on the edge of the bed for a minute can help to reduce the risk of these injuries.

A significant relationship was found between ISADL scores (one and three months after trauma) and cause of trauma. Elderly who experienced trauma outside of the home had higher scores. This is probably because they were more active before the trauma. Karbakhsh et al. (2006) in Tehran reported falls as the most common cause of trauma in elderly that usually occurred at home (8). Also, in the present study, most of the trauma occurred at home. In the study of Sipila et al. (2011), more than half of the trauma occurred at home (15). Perhaps elderly spend most of their time at home; thus, it is important to provide home safety measures for elderly.

The current study showed a significant relationship between ISADL scores (one and three months after trauma) and the type of trauma. Gill et al. (2013) found that the scores of disability related to hip fracture were significant (17). Also, a significant relationship was found between ISADL scores and location of injured organ. The lowest scores were in femoral trauma compared to pelvis trauma. Sipila et al. (2011) found that only 40% of survivors of hip fracture return to the levels of ability they had before the fracture (15). This issue shows the importance of long-term rehabilitation strategies after trauma, especially after femoral and pelvic fractures. The results of the present study showed a significant relationship between ISADL scores (one and three months after trauma) and having surgery, with patients with surgery having less independence. This is probably due to the short-term nature of the follow-up and the severity of the trauma.

Trauma is a common problem in elderly that can change them from independent people to bed-ridden individuals. Our study showed that most of the elderly were independent in ADL before trauma, but a huge number of them lost their independence after trauma, which can have emotional, physical, and economical consequences for both patients and their families. Unfortunately, no comprehensive program exists for prevention, treatment, and long-term rehabilitation after trauma in elderly in Iran. Our study showed the importance of such a program in the country. We also found that elderly with chronic diseases are prone to trauma, especially in the morning hours. Maybe simple education about the prevention of orthostatic hypotension or changing the time of the medications can prevent many cases of trauma in elderly. Most

of the injuries happened at home, highlighting the need for safety measures at home in elderly. These measures are well known and can be implemented with very low cost. Rehabilitation after trauma can make a huge difference in ADL. Unfortunately, these services are limited in our country and have high costs for patients. Knowing the predictive factors of dependence in ADL after trauma, as we listed in this article, may help health systems to design effective and realistic strategies for rehabilitative programs.

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## Footnotes

**Authors' Contributions:** Negin Masoudi Alavi was responsible for the study concept and design, made critical revisions to the paper, participated in data analysis, and supervised the study. Azade Safa participated in the development of the study concept, performed the data collection and literature search, and prepared the first draft of the manuscript. Masoumeh Abedzadeh revised the study draft.

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