Archives of Gerontology and Geriatrics 81 (2019) 8–17

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

Effectiveness of home based intervention program in reducing mortality of hip fracture patients: A non-randomized controlled trial

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ARTICLE INFO

Keywords:
Intervention
Hip fracture
Postoperative
Mortality
Mobility
Comanaged care

ABSTRACT

Purpose: The study was done to investigate whether a postoperative intervention program is effective in reducing mortality and improving mobility in two comparative hip fracture patients over one year postoperatively.
Methods: A non-randomized controlled trial study with an intervention group of hip fracture patients and historical control group with 12 months follow up.

One hundred twenty four admitted hip fracture patients to the Trauma Unit of Assiut University Hospitals, aged 50 years and older were included from 1st July to 31st December 2014. They were divided into 64 and 60 patients as intervention and control groups respectively. Weight, height and bone mineral density were measured and baseline characteristics were taken. The intervention was a postoperative care program in the form of education sessions with an explanatory leaflet on discharge for nutrition and physical exercise program at home. Follow up phone calls were done at 3 months, 6 months and one year postoperatively by one assessor. Physical mobility was assessed by 24 items Western Ontario And McMaster Universities Osteoarthritis Index (WOMAC).
Results: Mortality was significantly higher in the control group, WOMAC score was significantly better among intervention group through follow up. By multivariate Cox survival analysis, advancing age, no intervention, osteoporosis, postoperative complications, chest infections and heart attacks were significant predictors for mortality.
Conclusion: A significant improvement in mobility and reduction of mortality was achieved by application of a postoperative care program that could be incorporated into the hip fracture patients' care pathway.

1. Introduction

Hip fractures have become a major public health issue in the older people (Peeters et al., 2016). They are strongly related to low bone mineral density (BMD), and are associated with major morbidity, loss of independence, and even increased mortality than other common types of osteoporotic fractures (Siris, 2006). Hip fractures related to falls increase substantially with advancing age and less than half of older people hip fracture survivors regain their previous levels of activity (Lima et al., 2016). Mortality after hip fracture is mainly due to complications such as deep vein thrombosis, pulmonary embolism, pneumonia, and poor rehabilitation (Dharmarajan & Banik, 2006). During hospitalization, many complications are liable to develop (Friedman, Mendelson, Bingham, & Kates, 2009).

In a systematic literature review, it has been shown that patients with osteoporotic hip fracture are at considerable increased mortality risk compared with older people living in the community without a hip fracture ranging from 8.4% to 36% for the first year after fracture, and that the increased mortality risk is highest in the days and weeks following the index fracture and may persist for several years (Abrahamsen, Van Staa, Ariely, Olson, & Cooper, 2009).

Rehabilitation interventions with exercises have increasing evidence to have a positive impact on various functional abilities (Lima et al., 2016).

Abbreviations: BMD, bone mineral density; WOMAC, Western Ontario And McMaster Universities Osteoarthritis Index; DXA, dual-energy X-ray absorptiometry; CDC, Center for Disease Control and Prevention

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https://doi.org/10.1016/j.archger.2018.11.007
Received 31 March 2018; Received in revised form 8 November 2018; Accepted 12 November 2018
Available online 16 November 2018
0167-4943/

More than half of older people hip fracture survivors do not regain their pre-injury functional abilities even two years after injury (Magaziner et al., 2000). Early mobility and getting out of bed earlier before discharge and early postoperative walking ability decrease patient mortality (Siu et al., 2006).

It is crucial for those older people to restore their mobility in order to enable them to regain their indoor and outdoor activities. The recommended physical activity is the level that maintains social engagement and preserves autonomy. Ultimately, adequate mobility is a key component for an active and healthy ageing ("WHO, 2015," 2015). Exercise programs delivered in an intensive and supervised basis, have been found to improve the mobility of these patients (Binder et al., 2004).

The prevalence of malnutrition may reach up to 63% in older people hip fracture patients admitted to hospitals (Murphy, Brooks, New, & Lumbers, 2000). During hospital admission, the nutritional status could deteriorate further due to increased energy expenditure caused by blood loss and metabolic stress, combined with a low dietary intake due to the lack of appetite, nausea and psychological factors. Poor nutritional status in hip fracture patients is associated with impaired muscle function, disability (Lumbers, Driver, Howland, Older, & Williams, 1996), lower mental function, loss of independency, decreased quality of life (Patterson, Cornell, Carbone, Levine, & Chapman, 1992), delayed wound healing, higher complication rate (Paillaud, Bories, Le Parco, & Campillo, 2000), prolonged rehabilitation time (Paillaud et al., 2000; Patterson et al., 1992) and increased mortality during and after hospital admission (Paillaud et al., 2000). The late period of recovery, more than 6 months after hip fracture, has been explored in few studies (Sherrington, Lord, & Herbert, 2004). With expected bad nutrition status and decreased mobility, postoperative hip fracture mortality risk could increase in patients especially in absence of special comprehensive care in their health care systems as in developing countries. Trauma facilities incapable of applying comprehensive geriatric care may need an alternative intervention to improve the outcome of hip fractures in old patients. The effect of intervention program including education of physical exercises and nutrition to improve the outcome of those patients needs to be studied in comparison to patients undergoing the usual care. This may help in establishing an intervention by applying an efficient and postoperative care program before patient discharge, for patients in a situation with limited accessibility to rehabilitation service or comprehensive geriatric care after discharge in developing countries. The older patients are considered as crucial population in our region, and any instruction conducted to the caregivers for care of their parents and grandparents are usually well delivered. The aim of the study was to investigate whether postoperative intervention with nutrition plus physical exercise is effective in reducing mortality and improving mobility in older patients with hip fracture compared to a control group applying the usual care with one-year follow up.

2. Materials and methods

This study is a non-randomized controlled trial study (registered number in clinical trials.gov.; NCT03156075) designed as a prospective intervention group and a historical control group with 12 months follow-up.

2.1. Participants

The study included 124 patients of both sexes, 50 years and older who were admitted and surgically treated in the Trauma Unit of Assiut University Hospitals. To minimize other factors that could affect the data collection accuracy, dual-energy x-ray absorptiometry (DEXA) measurement and intervention program compliance, the exclusion criteria included patients with major accidents, polytrauma, bilateral hip fractures, mental dysfunction, long-term immobilization and musculoskeletal disorders. Sample size calculation was carried out using G*Power 3 software. A calculated sample of 102 patients was needed to detect an effect size of 0.5 in the minimal clinically important differences (MCIDs) for WOMAC. A study of patients with hip and knee OA undergoing comprehensive patient rehabilitation, the (MCIDs) for WOMAC global and subscale scores ranged from 0.67-0.75 for improvement ("Western Ontario and McMaster Universities Osteoarthritis Index (WOMUOI) (2018)), with an α error probability of 0.05 and 80% power. We added 20% for the sample to compensate for the expected drop outs in one year follow up with achieved total sample of 122 patients.

All hip fracture patients treated in Assiut University Trauma Unit are admitted in the same ward. To avoid any effect of the intervention program on the control group, enrollment of patients in both groups was done in different time periods. The first patient enrollment started in July 2014 and the final follow-up was completed at the end of December 2015 with one-year follow-up of all patients. All admitted hip fracture patients from July to the end of September 2014 were 142 cases. After applying inclusion and exclusion criteria, eligible patients were 71 and only 60 agreed to participate in the follow up phone calls over one year as a control group. All admitted hip fracture cases from October to the end of December 2014 were 151 patients. After applying the inclusion and exclusion criteria, 76 patients were eligible and only 64 agreed to participate in the intervention group.

The intervention program was tailored by a staff-member from the faculty of nursing. She trained two working nurses on application of each item of the intervention program and how to conduct the messages for the patients and their relatives. The two nurses were also trained on the contents of patient's guide leaflet and how to be demonstrated to the patients before leaving the hospital. Assurance of the accuracy and standardization of messages conduction for each nurse was done. The well trained nurses carried out personal interviews with all included patients. Data collection was conducted in the Trauma Unit ward with each patient and/or patients' relatives using a semi-structured questionnaire for baseline data. Data collection was done after providing informed consent. The questionnaire included socio-demographic characteristics such as name, sex, and age, associated comorbidities and some nutrition habits. The nutrition habits in pre and post intervention were evaluated by the dietary history qualitative subjective method using closed ended questions (Shim, Oh, & Kim, 2014). DEXA reports and anthropometric measurements in addition to the telephone numbers of the control group were recorded.

An independent investigator, not involved with recruitment or data collection, trained another team on the intervention program to conduct it for every selected patient in the intervention group.

2.2. Bone mineral density evaluation and anthropometric measurements

Bone mineral density (BMD) measurements of the femoral neck were assessed by DEXA scan,)Lunar DPX-L equipment(GE Lunar, GE Healthcare, US, as soon as possible postoperatively for all participants. From the measured BMD, sex-specific T scores were calculated. All DEXA measurements were carried out by one machine and the interpretations by the same radiologist. The criteria recommended by the International Osteoporosis Foundation and the World Health Organization were used to assess BMD. T score was classified to three groups as normal (T score ≥ -1 SD), osteopenic (T score from -1 to -2.5 SD), or osteoporotic (T score ≤ -2.5SD) (WHO, 1994). Height while lying down without shoes and weight were measured while the patients were dressed in light clothes. Body mass index (BMI) was

calculated from the height and weight recorded while performing DEXA scan. The BMI was calculated based on the formula: weight (kg)/[height (m)]^2. The standard categorization of BMI by Center for Disease Control and Prevention (CDC) indicates less than 18.5 as underweight, 18.5–24.9 as normal, 25.0–29.9 as overweight, and 30.0 and above as obese (Centers for Disease Control & Prevention, 2009).

2.3. The intervention protocol for the intervention group

A home-based program was carried out. The application of the program depended on good provision of the program at hospital before discharge for patients and caregivers.

Prior to the study, a standardized sufficient training was provided for two nurses. The well-trained nurses conducted an education session for each patient and one family member in the intervention group. The education session included postoperative nutrition and physical exercises for 20 to 30 min during the postoperative hospital stay. Patients received an orientation of the program contents, purpose and its impact on their health condition. The exercises included muscle strengthening and balance related exercises with promotion of early weight bearing after surgery. The instructed hip exercises in the patient's guide leaflet were planned according to the patient information leaflet of Hip Exercises of Oxford University Hospitals (Hip exercises information for patients, 2014). The leaflet was printed in Arabic language with written guides for exercises according to frequency and intensity by time in weeks. Exercises were illustrated in the leaflet by pictures for easy and precise application of the home-based exercise program. Nutrition guide was also written clearly. The session ends by summary of its contents and feedback from the patient and his relative to ensure program understanding. After intake of analgesics and subsidence of pain, patients in the intervention group were motivated to start mobility and tolerable exercise before discharge. A short second session was done immediately before discharge of every patient. The nurse reviewed with patient and his caregiver the patient's guide leaflet to make sure of understanding the program. Lastly, the patient received his patient's guide leaflet.

According to the standard care at the authors' hospital, all patients who will be operated upon are served by three meals that are rich in protein, carbohydrates, vitamins C, Calcium, zinc, iron and low in fats. They were advised to increase water drinking up to 3–4 liters/day.

Nutrition instructions included instructions about improving food habits for foods that augment calcium and vitamin D requirements, such as egg, milk and dairy products including cheese and yogurt. Increase the duration of exposure to sunlight was advised. They received education messages about factors decreasing the calcium absorption as drinks with excess caffeine and carbonated soft drinks. Nutrition instructions were also written in the patient's guide leaflet.

Patients were followed up at 3, 6, and 12 months to evaluate the patient's follow of guidance and his physical activity.

2.4. Control group

This group of patients received the usual care as a part of the hospital standard care. In the usual care; patients are instructed to start to move from bed with assistance within 24 h after surgery. No specific personal communication regarding nutrition or physical activity was provided. Prescription of calcium and vitamin D was done for all patients at discharge.

2.5. Follow up phone calls after intervention

The follow up phone calls were done for every patient in both groups at 3 months, 6 months and one year postoperative. All calls were done by one assessor; who could not be blinded to group allocation as the patients mentioned the intervention program during phone calls.

At one year, 12 cases (5 from the control and 7 from the intervention group) were dropped out due to unavailability after several trials to contact them by phone. The follow up of the intervention and historical control group with deaths and drop outs were illustrated in the flow chart of cases.

A follow up questionnaire was filled in by the assessor from the patient or his relative, who is responsible for the patient's care. The questionnaire consisted of three sections, the first one was asking about the patient if she/he is alive or not. If she/he died, reason for death and duration from the operation till death will be enquired. The second section was about the perioperative conditions as duration between the fracture and the index surgery and postoperative hospital stay. Also questions about the postoperative complications and health problems (pulmonary, cardiac, cerebrovascular stroke, urinary tract infections, depression and others) were included. The third section was about applying the nutrition guides as stop smoking and drinking milk, eating cheese and yogurt. Regular intake of calcium and vitamin D supplements was asked about.

Regularity of exercises and nutrition instructions was asked only for the intervention group.

Assessment of physical function and mobility of patients were done by the Western Ontario And McMaster Universities Osteoarthritis Index (WOMAC). WOMAC has been validated for telephone assessment (Bellamy, Campbell, Hill, & Band, 2002), and is available in over 65 alternate language forms, including Arabic (Guermazi et al., 2004), to assess pain, stiffness, and physical function in patients with hip and / or knee osteoarthritis (OA). WOMAC consists of 24 items divided into three subscales: 1- Pain (5 items): during walking, using stairs, in bed, sitting or lying, and standing. 2- Stiffness (2 items): morning stiffness after waking up and later in the day. 3- Physical function includes 17 items. A total WOMAC score is calculated by summing all three subscales items. Higher scores on the WOMAC indicate worse pain, stiffness, and functional limitations. Each item score ranged from 0 to 4 with total score of 96 (100%). Time to score was 10–15 minutes. WOMAC was chosen because it was developed for use among patients with knee and or hip OA and it has been used among patients with different conditions as: rheumatoid arthritis, low back pain, systemic lupus erythematosus and fibromyalgia. Furthermore, it has been extensively used in both epidemiological/ observational studies and to examine changes following treatments including arthroplasty, exercise, physical therapy, acupuncture and knee bracing ("Western Ontario & McMaster Universities Osteoarthritis Index (WOMUOI)). All studies reported high levels of reliability and internal consistency, demonstrating that the subscales' items are related to each other. The WOMAC reliability generally meets the criteria for group evaluation (McConnell, Kolopack, & Davis, 2001).

2.6. Ethical considerations

The study proposal was approved by the Ethical Review Board of our institution. Informed written consent was obtained from all participants prior to the study. Data confidentiality was preserved.

2.7. Statistical analysis

The statistical analyses were conducted on an intention-to-treat basis, in that participants were analyzed according to their group assignment, regardless of whether they complied with the study protocol. Total missing cases were 12 cases (9.7%), which are less than 20%, so no replacement of missing was needed.

Program effectiveness on mortality was considered as the primary

Table 1
Baseline patients' characteristics of admitted control and intervention pelvic fracture groups at Trauma Unit, Assiut University Hospitals.

Variables	Control group (No = 60)	Intervention Group (No = 64)	Total (No = 124)	P- value
Age Mean ± SD (Range)	72.8 ± 8.8	70.8 ± 11.03	71.8 ± 10.03 (50-99)	0.19*
Gender:				
Males	32 (53.3)	38 (59.4)	70 (56.5)	0.59**
Females	28 (46.7)	26 (40.6)	54 (43.5)	
Smoking	11 (18.3)	14 (21.9)	25 (20.2)	0.94***
Regular milk intake	25 (41.7)	29 (45.3)	54 (43.5)	0.76**
Regular cheese eating	33(55.0)	38 (59.4)	71 (57.3)	0.28**
Regular yogurt eating	23 (38.3)	27 (42.2)	50 (40.3)	0.77**
Egg daily eating	28 (46.7)	30 (46.9)	59 (47.6)	0.83**
Diabetes	17 (28.3)	19 (29.7)	34 (27.4)	0.64**
Heart disease	2 (3.3)	4 (6.3)	6 (4.8)	0.62**
Cerebrovascular Stroke	2 (3.3)	3 (4.7)	5 (4.0)	0.70**
Hypertension	19 (31.7)	21 (32.8)	40 (32.3)	0.46**
Cause of injury:				
Fall on ground	51 (85.0)	53 (82.8)	104 (83.9)	0.81**
Other mechanisms	9 (15.0)	11 (17.2)	20 (16.1)	
Fracture type:				
Fracture neck of femur	26 (43.3)	22 (34.4)	48 38.7	0.36***
Trochanteric	30 (50.0)	40 (52.5)	70 (56.5)	
Others	4 (6.7)	2 (3.1)	6 (4.8)	
Body mass index(BMI) Median (IQ range)	24.2 (4.7)	25.6 (3.1)	24.8 (3.5)	0.07*
Femur neck T- score mean	−3.41 ± 0.92	−3.21 ± 1.06	−3.21 ± 1.01	0.06*
Duration between fracture to operation (days)	(Range = 1.00 - 20.0 days)			
Median (IQ range)	5.5(5.0)	6.0 (4.0)	6.0(3.5)	0.53*
Hospital stay postoperative	(Range = 1.0 – 6.0 days)			
Median (IQ range)	1.0 (1.0)	2.0 (1.0)	2.0 (1.0)	0.42*
Hospital stay (days) Median (IQ range)	7.0 (4.8)	8.0 (4.0)	7 (4.0)	0.28*

Data are presented as Mean ± SD, N (%) or Median (IQ range).
P values were calculated using * Mann-Whitney U test, **Fisher's exact test, ***Chi-squared test.

Table 2
Post intervention characteristics for admitted control and intervention pelvic fracture groups at Trauma Unit, Assiut University Hospitals.

Variables	Control (No = 60)	Intervention (No= 64)	Total (No =124)	P- value
Smoking (Yes)	6 (10.0)	11 (17.2)	17 (13.7)	0.08*
Milk daily intake	16 (26.7)	27 (42.2)	43 (34.7)	0.03*
Cheese daily Regular	30 (50.0)	37 (57.8)	67(54.03)	0.61*
Yogurt daily intake	10 (16.7)	12 (18.8)	22 (17.7)	0.83*
Egg (daily eating)	32 (53.3)	30 (46.9)	62 (50.0)	0.61*
Postoperative problems	22 (36.7)	12 (18.8)	34 (27.4)	0.03*
Chest infections	4 (6.7)	2 (3.1)	6 (4.8)	0.43*
Heart attack	12 (20.0)	3 (4.7)	15 (12.1)	0.01*
Heart failure	6 (10.0)	3(4.7)	9 (7.3)	0.43*
Cerebrovascular stroke	0 (0.0)	2(3.1)	2 (1.6)	–
Urological inflammation	6 (10.0)	4 (6.2)	10 (8.0)	0.52*
DVT	1 (1.7)	0 (0.0)	1(0.8)	0.48*
Depression	2 (3.3)	0 (0.0)	2 (1.6)	0.23*
Regular sun exposure	6 (10.0)	24 (37.5)	30 (24.2)	< 0.001*
Mean duration of sun exposure (minutes) Median (IQ range)	0.0 (0.0)	0.0 (13.8)	0.0 (10.0)	0.23**
Strict to the intervention instructions regularly	–	49 (76.6)	49 (39.5)	–
WOMAC Score test Mean ± SD				
< 3 months (No)	40	56	96	< 0.001**
Median (range)	84 (17.0)	67 (23.0)	76.0 (22.0)	
3 months – < 6 months	35 (50.2 ± 14.9)	55 (42.8 ± 15.9)	90 (45.5 ± 15.9)	0.02**
6 months – 1 year	29 (40.0 ± 13.1)	40 (24.3 ± 12.9)	69 (30.9 ± 15.1)	< 0.001**
Death	26 (43.3)	17 (26.6)	43 (34.7)	0.04*
30 days●	13 (21.7)	6 (9.4)	19 (15.3)	0.01*
< 3 months	20 (33.3)	8 (12.5)	28 (65.1%)	0.01***
3 months - < 6months	5 (8.3)	1(1.6)	6 (14.0%)	
6 months – 1 year	1 (1.7)	8 (12.5)	9 (20.9%)	

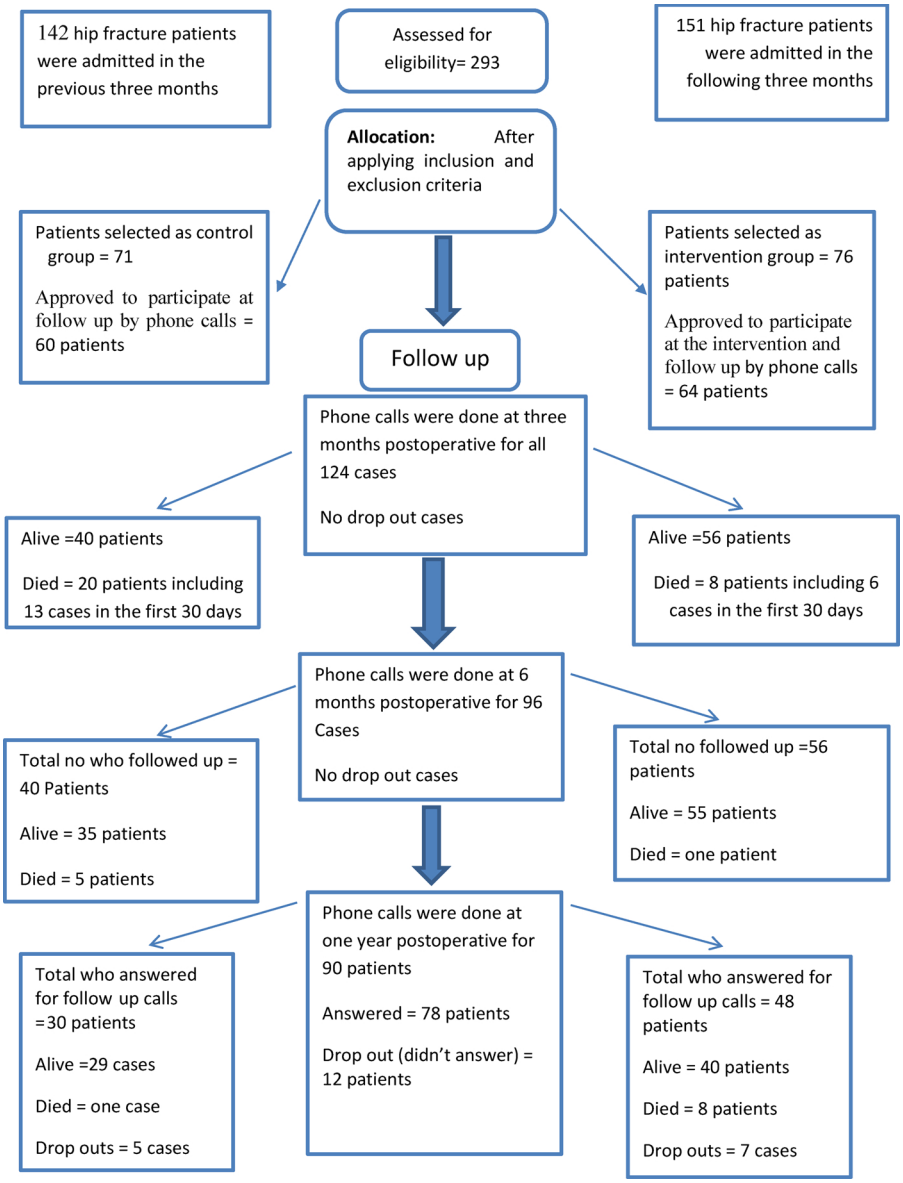
Data are presented as Mean ± SD, N (%) or Median (IQ range).
P- values were calculated using *Fisher's exact test, **Mann-Whitney U test, * **Chi-squared test.
●mortalities included in < 3 months category.

outcome measure, secondary outcomes were mobility, complications and nutrition during one year after hip fracture operation in comparison between the intervention and control group.

The data were presented with the use of standard descriptive statistics (mean and standard deviation (SD) for normally distributed continuous variables; median and interquartile range (IQ) for non-normally distributed continuous variables; absolute number and percentages for categorical variables). Analysis was done by using a non-parametric test, since most of the data did not exhibit a normal distribution. Mann Whitney U test was used for two random samples for continuous variables. Variables were presented as a number with corresponding percentage. When variables were categorical, differences between the groups were analyzed using the Chi-square test or Fisher's exact test for dichotomous variables.

Cox univariate analysis was performed to assess the predictors of mortality among the control and intervention group. The variables with a P- value < 0.15 at the univariate analysis were entered into a Cox regression model. Subsequently, variables with the highest P- value were removed using backward stepwise regression, until the fit of the model significantly decreased (based on the likelihood ratio test). The variables entered were age, gender, BMI, osteoporosis (Neck femur T score $\leq$ -2.5), mechanism of fracture, diabetes, hypertension, time to operation (days), hospital stay, intervention, post operative problems, chest infections, heart attacks, heart failure, cerebrovascular stroke, urological infection, depression, daily sun exposure, daily milk intake, daily cheese and egg eating. Odds ratio (OR) and 95% confidence interval (95% CI) were calculated. To avoid multicollinearity, cause of injury (fall on ground) was excluded from Cox multiple regression survival analysis because of its correlation with neck of femur bone mineral density. Kaplan-Meier analysis was used for one year survival curves, and log-rank tests were used to assess significance. Tests were two-sided and P- value was considered significant when it was 0.05 or less. Statistical analysis was carried out using the Statistical Package for the Social Sciences version 22 (SPSS Inc., Chicago, US).

Flowchart of cases:



3. Results

3.1. Patient characteristics

A total of 124 hip fracture patients were included in the study: 64 and 60 cases as intervention and control groups respectively. Their age ranged from 50 to 99 years with 71.8 ± 10.03 mean ± SD. Males were 56.5% (70). There was no statistical significant difference with respect to demographics, nutrition, comorbidity, cause of injury; hospital stay and mean T score ± SD (Table 1). Prevalence of osteoporosis was 74.2%.

3.2. Relationship between intervention and outcomes

As regards the nutrition habits, daily intake of milk was significantly higher in the intervention group (42.2%) than in the control group (26.7) with P-value = 0.03, but all daily milk drinkers were 34.7%. There was no significant difference in daily intake of cheese, yogurt, and egg with all frequency of regular eating of 50.0% and less. Only two cases and one case were drinking coffee and soft drinks regularly respectively.

Postoperative problems were higher significantly in the control group (36.7% & P-value = 0.03), heart attacks were higher significantly among the control group (20.0% & P-value = 0.01). Out of the intervention group, 37.5% had regular daily sun exposure significantly higher than the control group (10.0%) with P-value < 0.001. The mean WOMAC score ± SD was consistently significantly higher among the control group than the intervention group all over follow up. First 30 days mortality was 15.3% (19 cases), 13 of them in the control group with statistically significant difference between both groups. One-year mortality was 34.7%, which was significantly higher in the control than in the intervention groups (43.3% and 26.6% respectively) (Table 2).

3.3. Relationship between mortality and other factors by Cox univariate one year survival analysis and Kaplan- Meier survival analysis

By using univariate survival Cox test analysis, predictors for death were: age (OR = 1.2 & P-value = 0.01), osteoporosis (neck femur T score ≤ -2.5) (OR = 3.7 & P-value = 0.001), control group (OR = 5.4 & P-value = 0.02), postoperative problems (OR = 1.5 & P-value = 0.01), chest infections (OR = 7.9 & P-value < 0.001), heart attacks (OR = 7.3 & P-value < 0.001) and no daily sun exposure (OR = 3.5 & P-value = 0.01) (Table 3).

3.4. Predictors of one-year postoperative hip fracture mortality by multivariate Cox survival analysis

Cox multivariate one year survival regression analysis was performed using the total sample of 112 patients after exclusion of the drop out cases (12 cases) to identify predictors of one year mortality. The variables included in the analysis with their corresponding 95% confidence intervals (CI) and P-values are shown in Table 3. By using backward likelihood ratio method, increasing age, absence of postoperative intervention program, osteoporosis, occurrence of chest infections and heart attacks as postoperative medical problems were identified as highly significant predictors of postoperative hip fracture mortality in the studied sample. The risk of mortality increases by 1.1 for every year increase in the age (OR = 1.05; 95% CI: 1.01–1.08; P-value = 0.02); patients without intervention have a chance of increase in the risk of mortality by 1.2 times than the intervention group (OR = 1.21; 95% CI: 1.06–1.84; P-value = 0.04), presence of osteoporosis increases the risk of mortality by 1.5 times (OR = 1.51; 95% CI: 1.06–3.53; P-value = 0.04), and occurrence of postoperative problems increases the risk of mortality by 5.2 times than those without postoperative problems (OR = 5.23 ; 95 CI: 2.53–7.65; P-value < 0.001). The significant postoperative complications were chest infections and heart attacks with increase the risk of death by 2.8 and 1.6 times respectively (OR = 2.78; 95% CI: 1.59–4.88 ; P-value = 0.02) and (OR = 1.57; 95 CI: 1.02–3.62; P-value = 0.04).

By Kaplan Meier one year survival analysis, the survival time was significantly lower in control group (Fig. 1) with high significant Log Rank test (P-value = 0.03), also the survival time was lower in those with postoperative problems than the other group (Fig. 2) with highly significant Log Rank test (p < 0.001).

4. Discussion

Hip fracture is a major cause of morbidity and mortality amongst the older people (Peeters et al., 2016). Most deaths occur in the first 3–6 months after the event, but thereafter mortality remains higher than that of the general population (Empana, Dargent-Molina, & Bréart, 2004). The goal of rehabilitation after fracture is to restore the patient to the pre-injury activity status and avoid immobility consequences and death. In most cases, rehabilitation should begin immediately after surgery. Effectiveness of exercise after hip fracture was reported by several studies as increasing muscle strength and improving mobility (Portegijs et al., 2012).

The evaluation of a home based intervention program effectiveness after hip fracture surgery is required especially in developing countries, where patients may not be able to continue their postoperative care in a rehabilitation facility.

This study was designed to apply a home-based postoperative intervention program to patients aged 50 years or older, admitted with hip fracture to the Trauma Unit of Assiut University Hospitals.

The baseline data of both groups, 60 patients in the control group and 64 in the intervention group, showed no significant differences in all characteristics. They belonged to an older population with mean age 71.8 ± 10.03 years, and 83.9% of fractures were due to fall on ground. The study showed more male patients (56.5%) approved to participate in the study than females who reported higher refusal of participation than males.

Patients with hip fracture often suffer from malnutrition both before the fracture and in the post-operative phase as reported in many studies (Carlsson, Tidermark, Ponzer, Söderqvist, & Cederholm, 2005; Lumbers, New, Gibson, & Murphy, 2001). The nutrition part of the intervention program included the available low cost items. Dairy products as a source for calcium, vitamins, minerals and proteins are essential for bone and muscle health. Patients who had daily intake of milk, cheese and yogurt were 43.5%, 57.3% and 40.3% respectively. This may reflect a state of diminished intake of dietary daily requirements of vitamin D among them malnutrition was found in 38% of patients with hip fracture in a recent study (Chevalley, Hoffmeyer, Bonjour, & Rizzoli, 2010).

After provision of the intervention program postoperatively, the daily milk intake was significantly higher in the intervention group. This difference is attributed to decrease in the daily milk intake in the control group (from 41.7% pre fracture to 26.7 post fracture) and the minimal change in the intervention group (from 45.3%–42.2%). This is may be due to the effect of the nutrition instructions to preserve an established good habit for better improvement, but the change in the control group could be attributed to postoperative loss of appetite and lack of intervention. This was not present in cheese and yogurt between both groups. As regards daily egg intake, no significant difference between both groups was recorded at the baseline and postoperative in both groups (nearly 50.0% out of all). The compliance of the older people for improving their nutrition habits was reported poor by many studies (Beck, Damkjær, & Tetens, 2009; Milne, Potter, & Avenell, 2005). Reasons for the poor nutritional status in older people are multifactorial and may be due to eating dependency, low physical and cognitive function, and chewing and swallowing problem (Lumbers et al., 1996). In spite of the specific care about nutrition in the

Table 3
Cox univariate and multivariate regression analysis of predictors of one year mortality in postoperative hip fracture patients admitted to Trauma Unit, Assiut University Hospitals.

Variables	Cox univariate analysis			Multivariate analysis		
	(OR) Odds Ratio	95% Confidence Interval (CI)	P- value	(OR)	95% (CI)	P- value
Age	1.2	1.01–2.65	0.01	1.1	1.01 -1.08	0.02
Gender	1.5	0.84 - 2.76	0.17			
BMI (obesity)	0.8	0.29 - 2.33	0.71			
Osteoporosis (Neck femur T score ≤ -2.5)	3.7	1.45 - 9.35	0.01	1.5	1.06-3.53	0.04
Fall on ground	5.4	1.29 – 22.22	0.02			
Diabetes	1.6	0.82 - 3.24	0.16			
Hypertension	0.99	0.46 - 2.15	0.99			
Time to operation (days)	1.1	0.99- 1.15	0.10			
Hospital stay	1.03	0.96 - 1.11	0.35			
Control group	1.5	1.10 - 2.14	0.01	1.2	1.06 -1.84	0.04
Post operative problems	7.9	4.15 -14.89	< 0.001	5.2	2.53- 7.65	< 0.001
Chest infections	7.3	2.73 - 19.18	< 0.001	2.8	1.59 - 4.88	0.02
Heart attacks	4.2	2.15 – 8.42	< 0.001	1.6	1.02 - 3.62	0.04
Heart failure	3.5	1.37 - 9.06	0.01			
Cerebrovascular stroke	6.02	1. 39 –26.64	0.02			
Urological infection	1.6	0.94 - 1.33	0.09			
Depression	1.4	0.11- 5.44	0.78			
No daily sun exposure	5.9	1.84 -19.24	0.01			
No daily milk intake	1.8	0.06 - 0.44	0.03			
No daily cheese eating	1.7	0.16 -1.02	0.05			
No daily egg eating	1.3	0.36 – 1.26	0.21			

All sample included in the analysis was 112, 69 alive and 43 dead cases.
BMI: Body mass index.

intervention program, the habits were not satisfactorily changed; the socioeconomic status in general is standing there. These points raise the interest in increasing the awareness and special care about the issue of nutrition.

Regular daily sun exposure was significantly higher in the intervention group by 37% versus 10.0% of the control group. Significance

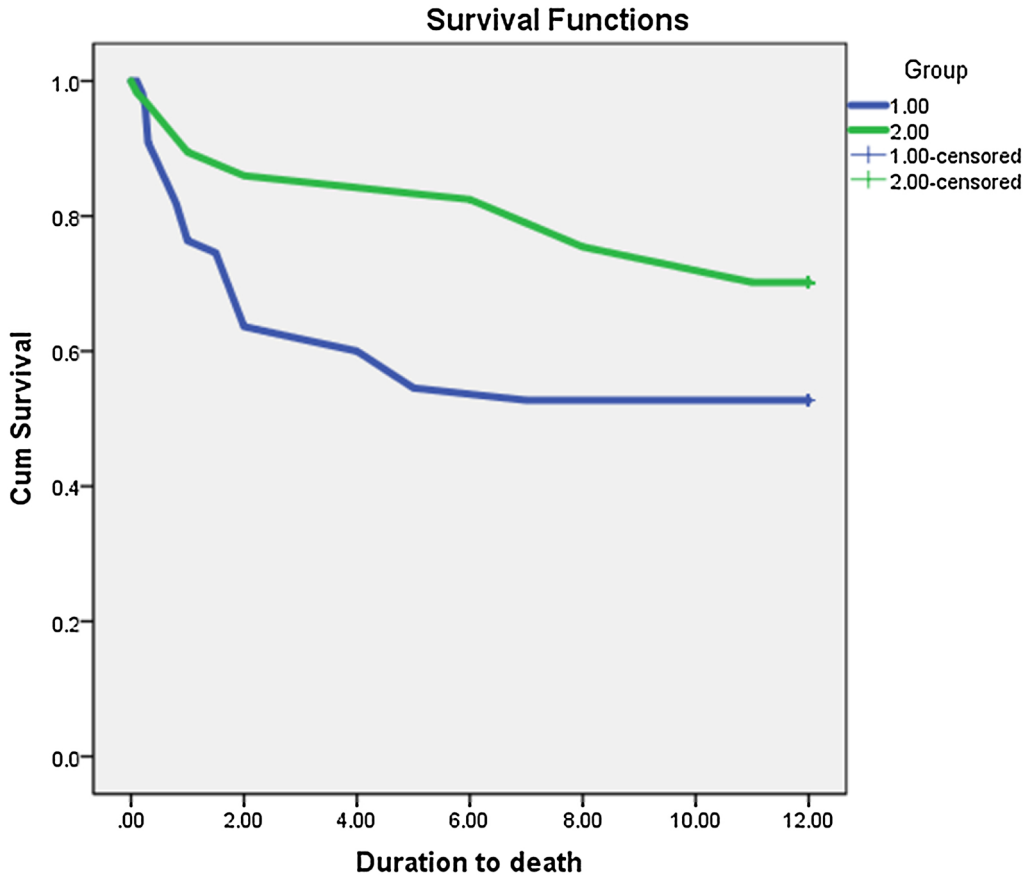


Fig. 1. Kaplan Meier one year mortality curve, comparing intervention and control patients groups (Log Rank (Mantel-Cox) P- value = 0.03).

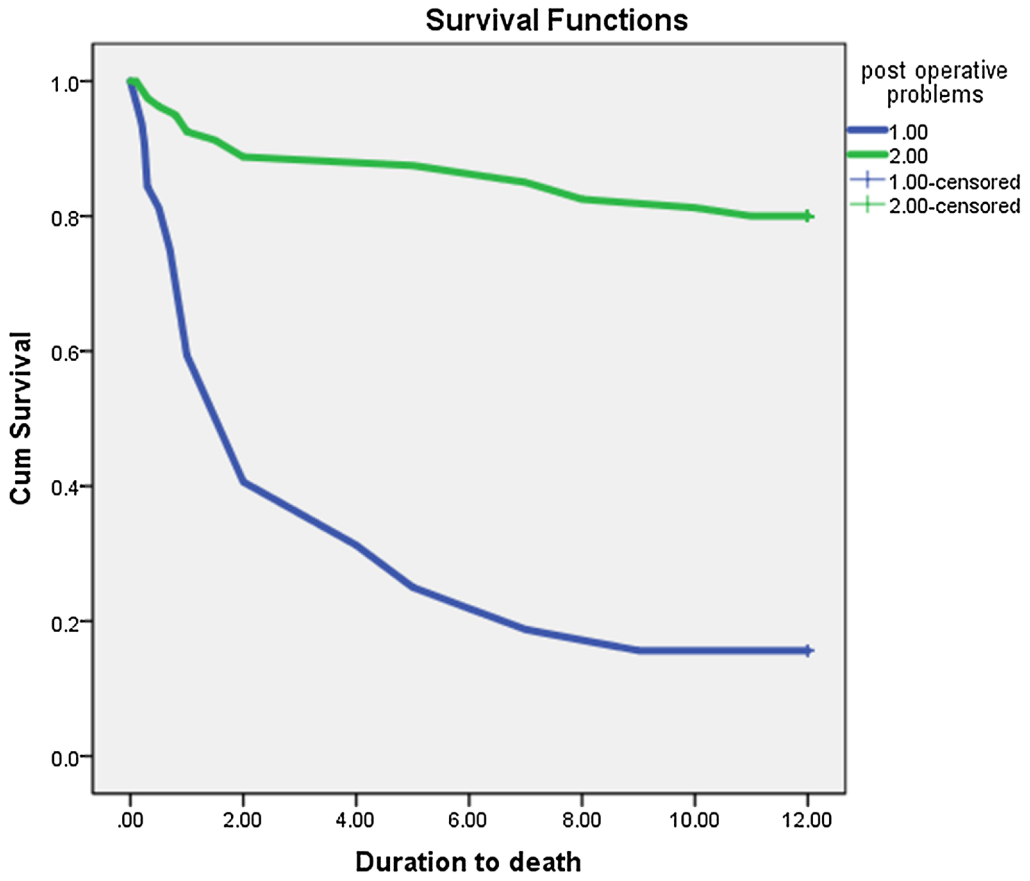


Fig. 2. Kaplan–Meier one -year mortality curve, comparing groups of patients with postoperative problems and patients without postoperative problems (Log Rank (Mantel-Cox) P- value < 0 0.001).

of sun exposure as a source of vitamin D was included in the intervention program.

The physical exercise program was more effective than the nutrition part in the intervention group. This was evaluated by WOMAC index, which was reported to be better in the intervention group in the three postoperative evaluation times with high significance. This improvement enabled the patients in the intervention group to have outdoor activities and hence, more sun exposure.

The mean time from fracture to operation had no significant difference between dead and alive cases, and the effect of surgical timing on mortality remains a controversial topic. Improvement in mortality following early surgical intervention was reported by various studies (Rae, Harris, McEvoy, & Todorova, 2007; Weller, Wai, Jaglal, & Kreder, 2005),but other studies did not (Holt, Smith, Duncan, Finlayson, & Gregori, 2008; Majumdar et al., 2006).

In the present study, postoperative medical complications were highly significant predictor for mortality by multivariate Cox survival analysis and by Kaplan Meier survival curve (< 0.001) and this is consistent with a multicenter retrospective cohort study including 1193 patients aged 50 years or older in 6 hospitals in Limburg trauma region of the Netherlands (Kalmet et al., 2016), and also with an Italian study (Pioli et al., 2006), Postoperative medical complications in the intervention group were less than that in the control group. This was reported in a Sweden study at Umeå University Hospital, which included 199 consecutive patients with femoral neck fracture, aged ≥70 years in comparing the outcome of applying a multidisciplinary clinical pathway to the usual care (Berggren, Stenvall, Englund, Olofsson, & Gustafson, 2016).

Cardiac attacks were significantly higher in the control group postoperatively. This was also reported by a Sweden study (Lisk & Yeong, 2014). Chest infections had the same finding in the present study, and both were significantly main predictors of one-year mortality as reported in UK study. Postoperative stroke (two cases only) and heart failure were not significant predictors by multivariate Cox survival analysis. This is not consistent with the Sweden study (Berggren et al., 2016) and the UK study that reported cardiac failure as the main cause of mortality (Lisk & Yeong, 2014).

Age was a significant predictor for one-year mortality. This was not found by other studies, such as the Sweden study (Berggren et al., 2016), Korean retrospective study conducted in Seoul (2009–2014) with 481 hip fracture patients (aged ≥65 years) (Choi et al., 2017), and the Italian prospective cohort study including 243 patients aged 70 and older (Pioli et al., 2006). Gender was not a significant predictor for mortality, which is in agreement with other studies (Berggren et al., 2016; Choi et al., 2017; Pioli et al., 2006). BMI was not a significant predictor for mortality as reported by the Korean study (Choi et al., 2017).

Osteoporosis was found to be a high significant predictor for postoperative hip mortality. There is a strong causative relationship of osteoporosis and hip fracture due to minor trauma (Panula et al., 2011; Siris, 2006). The prevalence of osteoporosis was 74.2% in all patients, which is nearly similar to a study including 275 hip fracture patients in the same institution (Farouk et al., 2017).

The mean length of hospital stay was found to be 8.0 ± 3.8 days with no significant difference between dead and alive cases. The hospital stay was not found a significant predictor in Korean study (Choi et al., 2017) [39]. Also, it is lower than that in St Peter's Hospital in UK, 2013 with a mean of 21.8 days (Lisk & Yeong, 2014).

Intervention group showed significant better WOMAC score and significant decrease in mortality. This reflects the effect of early mobility and physical exercise before and after discharge on patient's mortality, which is in agreement with other studies (Hirose et al., 2010; Siu et al., 2006). Also, this reflects the value of applying this home-

based postoperative intervention program for hip fracture patients to improve their outcome.

Mortality rate: Mortality within 30 days postoperative was found to be 15.3%, which was higher significantly in the control than in the intervention group (21.7% and 9.45% respectively, $p = 0.01$). It is higher than that of a study in Netherlands with 6.0%, (Kalmet et al., 2016). It is also higher than that of a meta-analysis study including 20,988 patients reporting one-month mortality of 13.3% (Hu, Jiang, Shen, Tang, & Wang, 2012). It was reported to be 7.5% in 850 patients aged ≥ 70 years with surgically treated hip fracture in Department of Trauma Surgery, in Netherlands. (Nijmeijer, Folbert, Vermeer, Slaets, & Hegeman, 2016). A lower rate of 5.3% was reported in St Peter's Hospital in UK (Lisk & Yeong, 2014). In the Korean study it was 7.3% in 6 months mortality (Choi et al., 2017).

Overall one-year mortality was 34.7%, which is lower in mortality than a study done in UK in 2640 patients (43.1%) (Stewart, Chantrey, Blankley, Boulton, & Moran, 2011), but higher than 27.3% in the Finns 65 years of age or older who were collected on a cohort-basis (Panula et al., 2011).

The limitations of the study include a possible hidden selection bias due to lack of randomization. The control and intervention groups were included in different periods of time to avoid any effect on the control group by the intervention program because all hip fracture patients treated in the trauma unit are admitted in the same ward. Moreover, the study included referred patients to a tertiary care hospital from different areas of Upper Egypt for management, which is offered free of charge. This might have excluded patients treated in other facilities who possibly had higher socioeconomic status, different nutrition habits and compliance to the nutrition intervention. Using self-report method in frail populations and the non-blinded assessor are other limitations.

Despite such limitations, the study provides an effective home-based postoperative intervention, enhancing early mobility and reducing morbidity and mortality of older patients with hip fracture. This home-based program is required in some situations as in a busy facility with high caseload and for patients with limited accessibility to rehabilitation service or comprehensive geriatric care after discharge. Older patients are considered as crucial population in our region. Health education messages conducted to the caregivers for care of their parents and grandparents are usually well delivered and will be meticulously applied.

5. Conclusion

A significant improvement in mobility and reduction of mortality was achieved by application of a postoperative care program which could be incorporated into the pathway of care for hip fracture geriatric patients, especially for patients with limited accessibility to rehabilitation service or comprehensive geriatric care after discharge.

Conflict of interest statement

Dalia G. Mahran, Osama Farouk, Mervat A. Ismail, Mohamed M. Alaa, Amr Eisa and Islam I. Ragab declare that they have no conflict of interest.

Funding source

This study was funded by AO Foundation, AOTrauma, Switzerland [grant number ME_2012_08].

Acknowledgement

We would like to appreciate the support of the AO Foundation for funding. Also we acknowledge the assistance of all the team of Assiut University Trauma Unit.

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