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Original Article

Factors affecting mortality and hospital admissions after hip surgery among elderly patients with hip fracture in Hong Kong — Review of a three-year follow-up☆

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Summary *Objective:* Hip fracture is associated with excess mortalities and high rate of hospital re-admission after discharge from the indexed episode. To improve related post-discharge care, we aimed to find out characteristics that were associated with related higher rates of mortality and hospital re-admission.
Methods: This was a historical cohort study with following up of 273 patients recruited in a local rehabilitation hospital for 3 years. The outcome of interest was cumulative mortalities and hospital re-admissions in the 1st 3 years after their discharge from the rehabilitation hospital. These outcomes were collected in the hospital data warehouse — the Clinical Data Analysis and Reporting System (CDARS). Eighteen predictors, as proposed by similar studies and our own review, were retrieved from our standard clinical forms as well as from the CDARS. Binary logistic regression was used to test their association with the outcomes and to generate the respective odd ratios.
Results: The cumulative overall mortality rates at 0.5-, 1-, 2- and 3- year after hip fracture were 7.2%, 14.0%, 24.6% and 33.4% respectively, while the cumulative "1st ever hospital readmission" at 0.5-, 1, 2- and 3- years after hip fracture were 29.4%, 41.6%, 59.4% and 71.7%

Conflict of Interest (If present, give more details): Nil.

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respectively. The most significant predictors i) for mortality at 3- year were: "Being male" (OR 5.33), "Delayed surgery >48 hours" (OR 2.65), "pre-operation albumin level <3.5 g/dl" (OR 2.66), and, ii) for "1st ever hospital readmission" at 0.5-year was "Being Assisted walker or non-walker (after rehabilitation)" (OR 3.83).
Conclusions: Characteristics that define the groups of patients with hip fractures with higher mortality and rate of hospital re-admission were identified. This could help healthcare professionals to focus on target patient groups for closer monitoring and more intensive post-discharge care.

Introduction

Hip fractures in the elderly are reported to be associated with excess mortality and higher risks of hospital readmissions within the first few years after the indexed episode (Man, Ho and Wong, 2016; Haentjens et al., 2010; Ottenbacher et al., 2003). This implies that, beyond the initial surgical intervention and the immediate post-operation rehabilitation, there should be rooms for further improvement especially in discharge planning and post-discharge community support in order to improve the health and quality of life of this group of elderly patients. Hopefully these improvements may also have a potential impact on saving the related health care costs. Moreover, as the volume of hip fractures is estimated to be escalating (Kung, Yates and Wong, 2007), finding out subgroups who are at even higher risks for mortality and hospital readmissions than the others may help to focus resources on the most needy patients. Many overseas studies proposed various risk factors e.g. the fracture sites, presence of co-morbidities, functional impairment before the fracture, albumin level, anaemia, etc. to be associated with increased mortality and higher rate of hospital readmissions (Beloosesky, Weiss, Grinblat, Brill & Hershkovitz, 2004; French, Bass, Bradham, Campbell & Rubenstein, 2008; Giusti et al., 2008; Hu, Jiang, Shen, Tang & Wang, 2012; Meesen et al., 2014; Pimlott, Jones, Beaupre, Johnston & Majumdar, 2011; Roche, Wenn, Sahota & Moran, 2005; Shiga, Wajima and Ohe, 2008; Smith, Pelpola, Ball Ong &Myint, 2014). However, these findings cannot be directly applied to the local context due to cultural difference. This study aimed to review the cumulative mortality and rate of ever hospital re-admission in the first 3 years after the indexed fracture, and, identify factors which would be associated with the related higher rates.

Methods

This study was a historical cohort study in design and was conducted in Kowloon Hospital (Centre B), one of the sub-acute convalescent hospitals in Hong Kong. Subjects who were transferred from Centre A — the acute hospital, Queen Elizabeth Hospital (QEH) to Centre B for rehabilitation after hip surgery during the period January—December 2010 were the potential subjects to be included. To be eligible, subjects had to be >65 years old, and, had an "International Classification of Diseases, Ninth Revision, Clinical Modification" (ICD9-CM) diagnostic code of 820.09 to 820.9: all intracapsular & extra-capsular fractures over hip. Subjects with the following conditions were excluded: a) with hip fracture attributed to bone cancer or Paget's disease, b) with associated fractures on admission other than the index fracture, c) had received hip surgery in other hospitals before admitted to Centre A, d) only received conservative treatment for hip fracture in Centre A, and, e) transferred back to Centre A for further management due to wound infection, medical problems or other problems during their stay at Centre B.

The potential predictive factors included in this study included: age, gender, pre-morbid residence, age adjusted Charlson Co-morbidity Index (CCI), types of fracture & operation, duration from injury to surgery, albumin level before the operation, haemoglobin (Hb) level after the operation, cognitive impairment based on the Abbreviated Mental Test (AMT) on admission to Centre B, ability in activities of daily living (ADL) based on Functional Independence Measures (FIM) as on admission to KH (most of them were transferred from Centre A on post-operation day 5—14 after stabilization of medical conditions) & discharge from Centre B, walking ability before the fall accident leading to the hip fracture and at discharge from Centre B, attendance to Geriatric Day Hospital (GDH) for further rehabilitation upon discharge from Centre B, length of stays (LOS) in Centre A and Centre B respectively. These variables were chosen based on our prior work (Chin, Ng and Cheung, 2008) as well as various international reports (Beloosesky et al., 2004; French et al., 2008; Giusti et al., 2008; Hu et al., 2012; Meesen et al., 2014; Pimlott et al., 2011; Roche et al., 2005; Shiga et al., 2008; Smith et al., 2014). All these information were retrieved from two sources: i) the "HIP Form", a standardized form having been adopted by our team since 2008, for recording multidisciplinary assessment results upon admission into and rehabilitation outcomes at discharge from our rehabilitation program, and, ii) the Clinical Data Analysis & Reporting System (CDARS) — the electronic data warehouse of the Hospital Authority, Hong Kong, by an independent therapist who was blind to the study hypothesis and outcomes.

The events of interest of our follow-up were mortality and hospital admissions through emergency department for all reasons within the first 3 years after the indexed hip fracture. These events as well as their respective dates were retrieved from the CDARS. The cumulative mortality rate & the 1st ever hospital readmission rate were calculated at 0.5-, 1-, 2- and 3-year intervals after the index hip fracture.

Statistical Analysis

All potential predictors for mortality and hospital readmissions were put into logistic regression analysis as covariates, using the 'Enter method' to validate their potential risk, and, to estimate their respective odd ratios (ORs). All statistical analyses were performed with the Statistical Product and Service Solutions version 21.0 (SPSS, Inc., Chicago, IL, USA). Ethical approval was obtained from the Research Ethics Committee (Kowloon Central/Kowloon East) [Reference number: KC/KE-13-0098/ER-1]. We put special emphasis on the procedures for keeping the confidentially of patients' information and data in order to protect their privacy.

Results

Two hundred and ninety-four patients, who met the inclusion criteria, were included in the follow-up. However, due to the loss of essential information of one patient, 293 patients were finally included in our analysis. Their baseline profiles and conditions at the discharge from the rehabilitation centre were listed in Table 1. Male to female ratio was 117/176 (male 39.9%, female 60.1%) and their average age was 83.1(SD = 6.8). At the time of their admission to hospital, 66 (22.5%) cases were from old aged home (OAH) while 227 (77.5%) cases were from home. There were 148 (50.5%) cases diagnosed as inter-trochanteric hip fractures and 145 (49.5%) cases diagnosed as sub-capital hip fracture. There were 118 (40.3%) patients who received partial hip replacement — Austin Moore Arthroplasty (AMA), and, 175 (59.7%) patients who underwent "Closed Reduction and Internal Fixation" (CRIF). Among these patients with CRIF, 140 (80.0%) patients received Gamma Nail (GN), and 35 (20.0%) patients received Dynamic Hip Screw (DHS). The length of stay (LOS) in the acute hospital was 12.4 (SD = 8.5) days while the LOS in the rehabilitation centre was 28.4 (SD = 20.7) days. More male patients tended to stay shorter in the acute hospital than the female patients. Upon discharge from the rehabilitation hospital, there were 133 (45.4%) patients had FIM score over 90 (i.e. generally independent in personal ADL), and, there were 52 (17.8%) patients need to change their living settings from home to OAH care after the indexed hip fracture. Fifty-seven of them (19.5%) were referred to Geriatric Day Hospital (GDH) for continuation of rehabilitation after hospital discharge.

The overall cumulative mortality rates at 0.5-, 1-, 2- and 3- year intervals after the indexed hip fracture were 7.2%, 14.0%, 24.6% and 33.4% respectively while the cumulative mortality rates for the female patients and the male patients at 0.5-, 1-, 2- and 3- year intervals were "4.5%, 9.1%, 17.6%, 24.4%" and "11.1%, 21.4%, 35.0%, 47.0%" respectively (Table 2). The mortality rate for the male patients at each of the time interval was significantly higher than that of the female patients. Related to the causes of death of these 98 patients, 70 (71.4%) patients died of medical issues, 14 (14.3%) patients died of surgical problems and 14 (14.3%) patients died with reasons could not be identified in the CDARS. For medical issues, 46 (65.8%) cases were related to chest infection, 18 (25.7%) cases had heart disease, 4 (5.7%) cases suffered from stroke, 1 (1.4%) case had renal disease and 1 (1.4%) case died due to urinary tract infection (UTI). The overall cumulative "1st ever hospital readmission" rates at 0.5-, 1-, 2- and 3- year intervals after the indexed hip fracture were 29.4%, 41.6%, 59.4% and 71.7% respectively (Table 2). There was no significant difference between the re-admission rates of the female and male patients at each of the time intervals. Medical reasons were also the major causes for hospital re-admissions.

On reviewing predictors for mortality, results of the binary logistic regression identified that "Being male" and "Delayed surgery >48 hours" were factors associated with increased mortalities at three of the four time intervals, starting at interval 1-year onwards. The Odd Ratios (ORs) ranged from 2.47 to 5.33 (Table 3). "Pre-operation albumin level <3.5 g/dl" was also a factor associated with increased mortalities at three of the four time intervals, but with one interval at an earlier time, i.e. 0.5-year. "With cognitive impairment upon admission" (i.e. with Abbreviated Mental Test score ≤5 together with any one or all of the following features of inattention, disorientation, poor memory, and, poor judgement for safety in daily activities being assessed in the first three days of admission to our rehabilitation center), and, "FIM < 90 upon discharge from Rehabilitation" were also associated with increased mortalities at the later time intervals, i.e. 2- and 3- year. On the other hand, "Length of stay of 28 days or longer in Rehabilitation Settings" seemed to protect the patients from the risk for increased mortality at the 1-year, while on the other hand "with no GDH attendance upon discharge" seemed to be associated with higher mortality at the 3-year interval. On reviewing predictors for "1st ever Hospital re-admissions" "Assisted walker or non-walker" was the sole factor associated with higher risk for hospital re-admissions for most of the time intervals (Table 4). The ORs ranged from 2.37 to 3.87. "Being male" and "FIM < 90 upon discharge from Rehabilitation" were associated with higher risk for hospital re-admission at the earlier time intervals, i.e. 0.5- and 1- year, while "Age > 80" were associated with higher risk at the later time intervals, i.e. 2- and 3- year.

Discussion

Our study produced data of cumulative mortality and hospital readmission for local reference. The findings were similar to other overseas studies. We hope these data would help us in planning the scope of post-discharge care programme in future, including liaising with potential community support teams to develop collaborative care programme to ensure better transition from the hospital to long-term care in the community. Related to particular patients group for focused care, the following characteristics may help: "being male", "lower pre-operation albumin level", "patients with delayed hip surgery", "unable to achieve independent walking upon completion of the rehabilitation program".

Male gender has higher risks of death and hospital readmission when being compared to female. This finding is consistent with other studies (Endo, Aharonoff, Zuckerman Egol & Koval, 2005; Mizrahi, Arad, Fleissig & Adunsky, 2014). Given that the life expectancy of male is shorter than female, to have related data seemed reasonable.

Table 1 Baseline & Discharge Characteristics of Included Patients Stratified According to Predictive Variables

		All (n = 293)		Female (n = 176)		Male (n = 117)		p
		Number	(%)	Number	(%)	Number	(%)	
Baseline Characteristics								
Age	0 ≤ 80	93	(31.7%)	50	(28.4%)	43	(36.8%)	0.13
	1 = ≧80	200	(68.3%)	126	(71.6%)	74	(63.2%)	
Site of hip fracture	0 = Inter-trochanteric	148	(50.5%)	86	(48.9%)	62	(53.0%)	0.49
	1 = Sub-capital	145	(49.5%)	90	(51.1%)	55	(47.0%)	
Duration: injury to surgery	0 = duration ≤2 days	203	(69.3%)	121	(68.8%)	82	(70.1%)	0.81
	1 = duration> 2 days	90	(30.7%)	55	(31.3%)	35	(29.9%)	
Operation type	0 = CRIF(GN&DHS)	175	(59.7%)	107	(60.8%)	68	(58.1%)	0.65
	1 = Partial hip replacement	118	(40.3%)	69	(39.2%)	49	(41.9%)	
CCI level (Age-adjusted)	0 = CCI ≤ 4	227	(77.5%)	140	(79.5%)	87	(74.9%)	0.30
	1 = CCI>4	66	(22.5%)	36	(20.5%)	30	(25.6%)	
Pre-op Albumin level	0 = ≧3.5 g/dl	211	(72.0%)	124	(70.5%)	87	(74.4%)	0.47
	1 ≤ 3.5 g/dl	82	(28.0%)	52	(29.5%)	30	(25.6%)	
Peri-op severe anaemia	0 = absence (Hb≧8 g/dL)	208	(71.0%)	124	(70.5%)	84	(71.8%)	0.80
	1 = presence (Hb < 8 g/dL)	85	(29.0%)	52	(29.5%)	33	(28.2%)	
Post-op Hb < normal	0 = absence	30	(10.2%)	20	(11.4%)	10	(8.5%)	0.44
Female < 11.7 g/dL & male < 13.4 g/dL	1 = presence	263	(89.8%)	156	(88.6%)	107	(91.5%)	
Post-op Blood transfusion	0 = no blood transfusion	111	(37.9%)	106	(60.2%)	76	(65.0%)	0.41
	1 = blood transfusion	182	(62.1%)	70	(39.8%)	41	(35.0%)	
Residence $_{pre\text{-}morbid}$	0 = Home	227	(77.5%)	139	(79.0%)	88	(75.2%)	0.45
	1 = OAH	66	(22.4%)	37	(21.0%)	29	(24.8%)	
Cognitive impairment	0 = Nil	196	(66.9%)	120	(68.2%)	76	(65.0%)	0.57
	1 = present	97	(33.1%)	56	(31.8%)	41	(35.5%)	
Walking ability $_{pre\text{-}morbid}$	0 = Independent walker	188	(64.2%)	101	(57.4%)	87	(74.4%)	0.00*
	1 = Assisted walker/non-walker	105	(35.8%)	75	(42.6%)	30	(25.6%)	
FIM $_{admission}$	0 = FIM≧75	94	(32.1%)	63	(35.8%)	31	(26.5%)	0.10
	1 = FIM < 75	199	(67.9%)	113	(64.2%)	86	(73.5%)	
Discharge Characteristics								
Residence $_{discharge}$	0 = Home	175	(59.7%)	111	(63.1%)	64	(54.7%)	0.15
	1 = OAH	118	(40.3%)	65	(36.9%)	53	(45.3%)	
Walking ability $_{discharge}$	0 = Independent walker	44	(15.0%)	25	(14.2%)	19	(16.2%)	0.63
	1 = Assisted walker/non-walker	249	(85.0%)	151	(85.4%)	98	(83.8%)	
FIM $_{discharge}$	0 = FIM ≥ 90	133	(45.4%)	134	(76.1%)	75	(64.1%)	0.03*
	1 = FIM<90	160	(54.6%)	42	(23.9%)	42	(35.9%)	
LOS − acute hospital	0 = ≦7 days	79	(27.0%)	31	(17.6%)	48	(41.0%)	0.00*
	1=>7 days	214	(73.0%)	145	(82.4%)	69	(59.0%)	
LOS − rehabilitation hospital	0 = ≦28 days	171	(58.4%)	108	(61.4%)	63	(53.8%)	0.20
	1=>28 days	122	(41.6%)	68	(38.6%)	54	(46.2%)	
GDH attendance	0 = had GDH FU	57	(19.5%)	24	(13.6%)	33	(28.2%)	0.00*
	1 = no GDH FU	236	(80.5%)	152	(86.4%)	84	(71.8%)	

CCI = Charlson Co-morbidity Index (CCI); OAH = old age home; FIM = Functional Independence Measure; LOS = length of stay; GDH = geriatric day hospital; FU = follow-up.
*p < 0.05 with Chi-square test.

According to the census report for the year 2011, life expectancy at birth estimated for "men" is 80.5 and for "women" is 86.7 in Hong Kong (Census and Statistics Department HKSAR, 2012), despite that there may be other reasons to consider including higher rate of infections and co-morbidities among the male patients (Wehren et al., 2003; Kurup and Mehta, 2006). Although these reasons could not be validated in our data, these are the potential clinical issues for looking into in the care of each individual patient. Another interesting aspects, which was related to gender difference and was identified in our study was: greater disability in terms of activities of daily living function and mobility at the time of discharge from the rehabilitation hospital were observed among our male patients when being compared to the female patients. In view that the male patients seemed to stay shorter in the acute settings than the female patients, we are not sure whether the female tends to be more expressive and assertive in communicating their discomfort and symptoms. This allows the clinicians to take corresponding investigations and interventions at an earlier time for the female. For the male patients, their problems might be under-reviewed. When

Table 2 Cumulative Mortality & Number/Rate of Emergency Admission "at Least Once" at Designated Follow-up Period.

Follow-up Time	Mortality Number (%)				Emergency re-admission — at least once Number (%)			
	All	Female	Male	p	All	Female	Male	p
0.5-year	21 (7.2%)	8 (4.5%)	13 (11.1%)	0.03*	86 (29.4%)	45 (25.6%)	41 (35.0%)	0.08
1-year	41 (14.0%)	16 (9.1%)	25 (21.4%)	0.00*	122 (41.6%)	66 (37.5%)	56 (47.9%)	0.08
2-year	72 (24.6%)	31 (17.6%)	41 (35.0%)	0.00*	174 (59.4%)	103 (58.5%)	71 (60.7%)	0.71
3-year	98 (33.4%)	43 (24.4%)	55 (47.0%)	0.00*	210 (71.7%)	122 (69.3%)	88 (75.2%)	0.27
Causes leading to:	Death				1st Emergency readmission			
1. Medical	70 46 — Chest infection 18 — Heart diseases 1 — Renal disease 4 — Stroke 1 — Urinary tract infection				149			
2. Surgical	14				15			
3. Orthopaedic	0				41			
4. Non-specific	14				5			

*$p < 0.05$ with Chi-square test.

communicating with the male patients, we need to be more patient and be observant, as we did not want to miss minor symptoms which might have a long term impact.

Patients with delayed hip surgery also had higher risk of death when being compared with patients received early surgery. Since 2009 there has been an intensive control for surgery as early as possible, i.e. within 48 hours after the introduction of new resources and the corresponding benchmarking monitoring exercise in Hong Kong (Muhm et al., 2014; Report of the Chairman, 2009 — COC in Orthopaedics and Traumatology, Hong Kong Hospital Authority, 2009). In case of delayed surgery, the reasons are usually patient-related medical conditions. The patients had medical complications exacerbated at the time of the hip fracture that were needed to be monitored and/or treated before the operation for the benefit of the patients. In addition, these patients remained at risk for developing new medical complications even after discharge from the hospital.

Low "Pre-operation albumin level" (i.e. <3.5 g/dl) is another important factor that defines elderly patient at higher risk for mortality, even at the earlier time interval. Albumin is a marker of nutritional status in clinically stable people, and, albumin levels below <3.5 g/dl are associated to a higher risk of post-surgery complications, especially infections (Pimlott et al., 2011). Bearing in mind that albumin could potentially be modified with appropriate intervention that means nutritional management should be an integrated part in the management of hip fracture among the elderly patients. The result of a study conducted in our setting supported that nutritional supplement did improve short-term outcomes, i.e. better functional improvement and more chance for discharge back home (Myint et al., 2013). Upon this result nutritional management became part of our routines starting from early 2015. Whether nutritional supplement would improve also mortality we will need further research to validate.

"Assisted walker or non-walker" was the sole factor associated with higher risk for hospital readmissions for most of the time intervals. That means on the contrary patients "with independent walking ability" tended to be healthier and stayed longer in the community without the need for hospitalization. It seems reasonable that patients "with independent walking ability" would be more likely to participate in daily walking. Daily walking should be good at both physiological and psychological health; it provides a kind of aerobic exercise and also opens up the door for the patient to fulfil lots of duties related to their role function, e.g. going outdoor for shopping, meeting friends, etc. Daily walking is also reported to be associated with decreased mortalities (Fortes et al., 2013; Samawi, 2013; Social Welfare Department — HKSAR, 2016). Thus, in our practice, the post-discharge community support service should go beyond providing personal care assistance, e.g. meals-on-wheel, assisted bathing, escort for medical follow-up, etc. Continuation of rehabilitation should also be emphasized. The related rehabilitation programme needed not be very sophisticated: it can be daily walking exercises, regular participation in all other daily living activities, etc. with assistance from the personal care workers. The local community support services for the frail elderly include rehabilitation in their scope of services, and, the working team providing related community support services include rehabilitation personnel, e.g. occupational therapists, physiotherapists as their team members (Social Welfare Department — HKSAR, 2016).

There were some limitations of our study. Firstly, the study population consisted of patients from a single rehabilitation department, and, the sample size was relatively small when compared to other observational studies about mortality and re-admission following hip fracture. They weaken the generalization of the study results and the statistical power of the study to identify certain risk factors. Secondly, we excluded those patients who had been transferred back to the acute hospital due to unstable medical conditions. We did not record the exact number of related patients in the subject recruitment period. But we estimated that this number was not small. As they were frailer we might have under-estimated both the mortalities and the rates of hospital re-admission. Thirdly, we did not

Table 3 Odd Ratios from Binary Logistic Regression for Factors Predicting Mortality at 0.5-, 1-, 2- & 3- Year Time Interval.

		0.5-year		1-year		2-year		3-year	
		OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Baseline Characteristics									
Sex	1 = Male	2.81 (0.97–8.13)	0.06	3.99 (1.70–9.40)	0.00*	3.64 (1.77–7.48)	0.00*	5.33 (2.59–10.98)	0.00*
Age	1 = ≧80	0.64 (0.02–2.08)	0.46	0.83 (0.31–2.21)	0.71	0.79 (0.36–1.74)	0.55	0.92 (0.44–1.92)	0.82
Site of hip fracture	1 = Sub-capital	0.38 (0.04–3.63)	0.40	0.60 (0.14–2.61)	0.50	0.62 (0.18–2.19)	0.46	2.57 (0.83–7.91)	0.10
Duration: injury to surgery	1 = duration> 2 days	1.41 (0.47–4.20)	0.54	2.50 (1.08–5.84)	0.03*	2.47 (1.23–4.96)	0.01*	2.65 (1.35–5.21)	0.01*
Operation type	1 = Partial hip replacement	3.60 (0.36–35.48)	0.27	1.79 (0.38–8.39)	0.46	1.35 (0.37–5.01)	0.65	0.36 (0.11–1.18)	0.09
CCI level (Age-adjusted)	1 = CCI>4	2.47 (0.85-7.17)	0.10	1.49 (0.62-3.59)	0.37	1.81 (0.88-3.74)	0.11	0.89 (0.43-1.84)	0.75
Pre-op Albumin level	1=<3.5 g/dl	3.19 (1.09–9.37)	0.04*	2.12 (0.91–4.95)	0.08	2.55 (1.25–5.20)	0.01*	2.66 (1.34–5.30)	0.01*
Peri-op severe anaemia	1 = presence (Hb < 8 g/dL)	0.58 (0.18–1.94)	0.38	1.45 (0.61–3.47)	0.41	1.05 (0.50–2.17)	0.90	1.75 (0.85–3.61)	0.13
Post-op Hb < normal[a]	1 = presence	0.57 (0.09–3.29)	0.50	0.69 (0.15–3.14)	0.63	0.59 (0.16–2.14)	0.42	0.89 (0.28–2.84)	0.84
Post-op Blood transfusion	1 = blood transfusion	1.89 (0.60–5.96)	0.28	1.87 (0.77–4.53)	0.17	1.44 (0.70–2.97)	0.32	1.35 (0.68–2.72)	0.39
Residence $_{\text{pre-morbid}}$	1 = OAH	0.96 (0.24–3.80)	0.95	0.86 (0.29–2.52)	0.78	0.92 (0.38–2.23)	0.86	0.49 (0.20–1.20)	0.12
Cognitive impairment	1 = present	2.01 (0.51–7.93)	0.32	1.58 (0.57–4.39)	0.38	2.46 (1.10–5.49)	0.03*	2.26 (1.03–4.93)	0.04*
Walking ability $_{\text{pre-morbid}}$	1 = Assisted walker or non-walker	0.52 (0.14–1.90)	0.32	1.40 (0.54–3.61)	0.49	1.09 (0.50–2.40)	0.83	1.70 (0.78–3.68)	0.18
FIM $_{\text{admission}}$	1 = FIM<75	1.38 (0.22–8.80)	0.73	1.60 (0.35–7.35)	0.54	1.92 (0.55–6.73)	0.31	1.72 (0.63–4.71)	0.29
Discharge Characteristics									
Residence $_{\text{discharge}}$	1 = OAH	1.42 (0.36–5.58)	0.62	1.10 (0.37–3.27)	0.87	1.01 (0.43–2.34)	0.99	1.29 (0.57–2.94)	0.54
Walking ability $_{\text{discharge}}$	1 = Assisted walker or non-walker	0.85 (0.14–5.18)	0.86	1.55 (0.27–8.77)	0.62	2.11 (0.52–8.50)	0.29	2.49 (0.77–8.04)	0.13
FIM $_{\text{discharge}}$	1 = FIM<90	1.43 (0.25–8.17)	0.69	1.83 (0.47–7.08)	0.38	3.01 (1.07–8.46)	0.04*	2.30 (0.95–5.59)	0.07
LOS – acute hospital	1=>7 days	1.28 (0.34–4.85)	0.71	0.94 (0.35–2.49)	0.90	0.86 (0.39–1.89)	0.70	0.52 (0.25–1.08)	0.08
LOS – rehabilitation hospital	1=>28days	0.38 (0.11v1.30)	0.12	0.20 (0.07–0.52)	0.00*	1.04 (0.52–2.08)	0.91	0.80 (0.42–1.53)	0.50
GDH attendance	1 = no GDH FU	2.12 (0.53–8.54)	0.29	2.75 (0.83–9.10)	0.10	2.49 (0.96–6.43)	0.06	2.90 (1.17–7.18)	0.02*

CCI = Charlson Co-morbidity Index (CCI); OAH = old age home; FIM = Functional Independence Measure; LOS = length of stay; GDH = geriatric day hospital; FU = follow-up.
*$p < 0.05$ with Binary Logistic Regression.
[a] The values indicating "Post-op Hb < normal" were different between female & male; their respective values were <11.7 g/dL for female & <13.4 g/dL for male.

Table 4 Odd Ratios from Binary Logistic Regression for Factors Predicting "1st Ever Hospital Admission" at 0.5-, 1-, 2- & 3- Year Time Interval.

		0.5-year		1-year		2-year		3-year	
		OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Baseline Characteristics									
Sex	1 = Male	2.04 (1.11—3.75)	0.02*	2.03 (1.13—3.64)	0.02*	1.30 (0.73—2.35)	0.38	1.45 (0.76—2.74)	0.26
Age	1 = ≧80	0.95 (0.50—1.83)	0.88	1.37 (0.74—2.53)	0.32	1.85 (1.03—3.33)	0.04*	2.20 (1.18—4.10)	0.01*
Site of hip fracture	1 = Sub-capital	0.79 (0.28—2.20)	0.64	0.82 (0.31—2.12)	0.68	1.43 (0.52—3.96)	0.49	2.01 (0.63—6.40)	0.24
Duration: injury to surgery	1 = duration> 2 days	1.51 (0.83—2.77)	0.18	1.67 (0.93—3.00)	0.09	1.26 (0.69—2.28)	0.45	1.01 (0.53—1.90)	0.99
Operation type	1 = Partial hip replacement	1.11 (0.39—3.19)	0.85	1.06 (0.40—2.81)	0.91	0.51 (0.18—1.42)	0.20	0.34 (0.11—1.09)	0.07
CCI level (Age-adjusted)	1 = CCI>4	0.86 (0.44—1.67)	0.66	1.31 (0.70—2.45)	0.40	1.30 (0.68—2.49)	0.44	0.85 (0.42—1.72)	0.66
Pre-op Albumin level	1=<3.5 g/dl	1.48 (0.79—2.76)	0.22	1.43 (0.78—2.62)	0.25	0.78 (0.42—1.46)	0.78	0.59 (0.30—1.16)	0.12
Peri-op severe anaemia	1 = presence (Hb < 8 g/dL)	0.89 (0.46—1.73)	0.73	1.02 (0.54—1.94)	0.94	0.72 (0.37—1.39)	0.33	0.76 (0.37—1.58)	0.47
Post-op Hb < normal	1 = presence	0.68 (0.26—1.79)	0.50	0.52 (0.21—1.30)	0.16	0.77 (0.31—1.91)	0.57	0.83 (0.31—2.18)	0.70
Post-op Blood transfusion	1 = blood transfusion	1.06 (0.59—2.00)	0.86	1.26 (0.68—2.31)	0.46	1.24 (0.66—2.32)	0.51	0.90 (0.45—1.80)	0.76
Residence $_{\text{pre-morbid}}$	1 = OAH	0.52 (0.23—1.18)	0.12	1.20 (0.55—2.62)	0.66	1.33 (0.56—3.20)	0.52	0.61 (0.22—1.69)	0.34
Cognitive impairment	1 = present	1.07 (0.52—2.20)	0.86	1.75 (0.87—3.50)	0.12	1.65 (0.79—3.45)	0.18	1.84 (0.77—4.36)	0.17
Walking ability $_{\text{pre-morbid}}$	1 = Assisted walker or non-walker	1.74 (0.89—3.43)	0.11	1.48 (0.78—2.81)	0.23	0.92 (0.48—1.79)	0.81	1.07 (0.51—2.23)	0.86
FIM $_{\text{admission}}$	1 = FIM<75	0.67 (0.27—1.67)	0.40	0.54 (0.24—1.21)	0.13	0.84 (0.40—1.77)	0.64	1.84 (0.83—4.08)	0.13
Discharge Characteristics									
Residence $_{\text{discharge}}$	1 = OAH	1.54 (0.73—3.23)	0.25	1.27 (0.63—2.56)	0.51	1.45 (0.70—2.99)	0.32	1.85 (0.80—4.29)	0.15
Walking ability $_{\text{discharge}}$	1 = Assisted walker or non-walker	2.31 (0.80—6.77)	0.12	3.83 (1.42—10.30)	0.01*	3.06 (1.37—6.86)	0.01*	2.37 (1.09—5.14)	0.03*
FIM $_{\text{discharge}}$	1 = FIM<90	2.85 (1.20—6.75)	0.02*	1.62 (0.76—3.45)	0.21	1.66 (0.80—3.44)	0.18	1.09 (0.48—2.49)	0.83
LOS — acute hospital	1=>7 days	0.99 (0.50—1.94)	0.97	0.89 (0.47—1.68)	0.72	1.43 (0.76—2.69)	0.27	0.91 (0.45—1.82)	0.78
LOS — rehabilitation hospital	1=>28days	0.80 (0.44—1.44)	0.46	0.82 (0.47—1.41)	0.46	1.06 (0.62—1.83)	0.83	0.88 (0.49—1.58)	0.67
GDH attendance	1 = no GDH FU	1.25 (0.59—2.63)	0.57	1.44 (0.72—2.90)	0.31	1.09 (0.56—2.12)	0.80	1.04 (0.51—2.12)	0.91

CCI = Charlson Co-morbidity Index (CCI); OAH = old age home; FIM = Functional Independence Measure; LOS = length of stay; GDH = geriatric day hospital; FU = follow-up.
*$p < 0.05$ with Binary Logistic Regression.
[#]The values indicating "Post-op Hb < normal" were different between female & male; their respective values were <11.7 g/dL for female & <13.4 g/dL for male.

have control over other important confounders, like smoking history and alcohol consumption, etc., in our multivariate analyses, as most deaths and hospital admissions were due to medical causes. Lastly, in case information on the dates of occurrences, i.e. death dates, dates of 1st hospital admission were known, Cox's proportional hazard model for the regression using time-to-event as the outcome would be more appropriate to be adopted for statistical analysis.

Conclusion

This historical cohort study provides local data for cumulative mortality rates and hospital re-admission at 0.5-, 1-, 2- and 3- year intervals after the indexed hip fracture among elderly patients. We also reviewed the following characteristics including, "being male patient", "with the related surgery done beyond 48 hours due to un-resolved medical issues", "with pre-operative albumin level below 3.5 g/dl" and "assisted or non-walker at the time of discharge from rehabilitation settings", as important factors associated with higher mortality and rate of hospital re-admission. This may help defining target groups of patients for closer post-discharge monitoring and care, and continuation of rehabilitation program in the community.

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