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Comprehensive and subacute care interventions improve health-related quality of life for older patients after surgery for hip fracture: A randomised controlled trial

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ABSTRACT

Background: Elderly patients with hip fracture have been found to benefit from subacute care interventions that usually comprise usual care with added geriatric intervention, early rehabilitation, and supported discharge. However, no studies were found on the effects of combining subacute care and health-maintenance interventions on health outcomes for elders with hip fracture.
Objectives: To compare the effects of an interdisciplinary comprehensive care programme with those of subacute care and usual care programmes on health-related quality of life (HRQoL) for elderly patients with hip fracture.
Design: Randomised controlled trial.
Settings: A 3000-bed medical centre in northern Taiwan.
Participants: Patients with hip fracture ($N = 299$) were randomised into three groups: subacute care ($n = 101$), comprehensive care ($n = 99$), and usual care ($n = 99$).
Methods: Subacute care included geriatric consultation, continuous rehabilitation, and discharge planning. Comprehensive care consisted of subacute care plus health-maintenance interventions to manage depressive symptoms, manage malnutrition, and prevent falls. Usual care included only 1–2 in-hospital rehabilitation sessions, discharge planning without environmental assessment, no geriatric consultation, and no in-home rehabilitation. HRQoL was measured using the Medical Outcomes Study Short-Form 36 Taiwan version at 1, 3, 6, and 12 months after discharge.
Results: Participants in the comprehensive care group improved more in physical function, role physical, general health and mental health than those in the usual care group. The subacute care group had greater improvement in physical function, role physical, vitality, and social function than the usual care group. The intervention effects for

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both comprehensive and subacute care increased over time, specifically from 6 months after hip fracture onward, and reached a maximum at 12 months following discharge. *Conclusions:* Both comprehensive care and subacute care programmes may improve health outcomes of elders with hip fracture. Our results may provide a reference for health care providers in countries using similar programmes with Chinese/Taiwanese immigrant populations.

What is already known about the topic?

- Elderly patients with hip fracture have been found to benefit from subacute care interventions that usually comprise usual care with added geriatric intervention, early rehabilitation, and supported discharge.
- Hip-fractured elders' health outcomes were found to be enhanced by health-maintenance interventions including nutritional supplements, fall prevention, and depression detection/management.
- No studies have explored the effects of combining subacute care and health-maintenance interventions on health outcomes for elders with hip fracture.

What this paper adds

- Comprehensive care which combines both subacute care and health maintenance-intervention groups improved physical function, role physical, general health and mental health for older patients following hip fracture.
- Subacute care improved physical function, role physical, vitality, and social function for older patients following hip fracture.
- The intervention effects for the comprehensive care and subacute care groups increased over time, specifically from 6 months after hip fracture onward, and reached a maximum at 12 months following discharge.

1. Introduction

Osteoporotic fractures in people >50 years old are a significant cause of morbidity and mortality worldwide, especially in developed countries (Johnell and Kanis, 2006). Indeed, the incidence of hip fracture was reported to be greater in industrialised countries such as North Europe and the US than in developing countries (Dhanwal et al., 2011). The number of osteoporotic hip fractures in 2000 was estimated to be 1.6 million worldwide (Johnell and Kanis, 2006), and this number was projected to increase by 2050 from 6.26 to 21 million (Parker and Johansen, 2006). By 2050 half of all hip fractures are also estimated to occur in Asia (Dhanwal et al., 2011). Hip fracture has led to 13–36% mortality within 1 year, 44–55.3% mortality within 4 years after fracture (Johansen et al., 2010; Pretto et al., 2010; Robbins et al., 2006), and excessive morbidity that severely impedes patients' health-related quality of life (HRQoL) (Randell et al., 2000; Shyu et al., 2004a,b).

Elderly patients, ≥60 or 65 years old, with hip fracture have been found to benefit from subacute care interventions that usually comprise usual care with added geriatric intervention, early rehabilitation, and supported discharge (Adunsky et al., 2003; Allegrante et al., 2007; Shyu et al., 2010a). The recovery of elderly persons after hip fracture is influenced by depressive symptoms, malnutrition, and falls (Shyu et al., 2008a, 2009; Symeonidis and Clark, 2006). Hip-fractured elders' health outcomes were found to be enhanced by health-maintenance interventions including nutritional supplements, fall prevention, and depression detection/management (Hedström et al., 2006; Schoenfelder and Van Why, 1997; Zimmerman et al., 1999). However, no studies have explored the effects of combining subacute care and health-maintenance interventions on health outcomes for elders with hip fracture, nor have any studies examined how the effects of adding health maintenance interventions to subacute care differ from those of a simple subacute care model. Furthermore, most studies on elderly patients' recovery after hip fracture used a non-randomisation design that seriously jeopardised their conclusions.

Self-rated health-related quality of life (HRQoL) (Greenfield and Nelson, 1992) has been suggested as a measure to supplement objective clinical parameters of patients with hip fracture (Bryant et al., 2009). However, interventions to improve the HRQoL of elders with hip fracture have had inconsistent effects (Binder et al., 2004; Crotty et al., 2010; Tsauo et al., 2005). In addition, few of them examined the longitudinal effects of interventions up to 1 year after discharge. Thus, little is known about the effects, specifically the long-term effects, of intervention programmes on HRQoL for elderly patients with hip fracture.

Our prior study showed that an interdisciplinary subacute care intervention improved health outcomes of elders with hip fracture (Shyu et al., 2010b). However, this intervention had much larger treatment effects on physical health-related outcomes than on mental health-related outcomes. At the same time, we found that this population was at risk for depression, malnutrition and subsequent falls (Shyu et al., 2009, 2010a). To better address the needs of this population, therefore, we developed a comprehensive care model. In the present study, we defined the subacute care model as an interdisciplinary approach provided over the 3 months following hospital discharge to help hip-fractured older persons recover to their pre-fracture level of self-care ability and improve their quality of life. This subacute care model included geriatric consultation, continuous rehabilitation, and supported discharge services in addition to routine care (Shyu et al., 2005, 2010a). The comprehensive care model was defined as a 1-year interdisciplinary approach which focused not only on rehabilitation, but also on health-maintenance services and provided physical care and emotional care. The health-maintenance interventions of this comprehensive care model included detecting and

managing nutritional problems and depressive symptoms, as well as preventing falls. The comprehensive care model also included components of the subacute care model and routine care. In this report, we compare the effects of the comprehensive care model, subacute care model, and usual care on HRQoL of hip-fractured elders within 1 year after discharge.

We reasoned that adding health-maintenance interventions to subacute care to create a comprehensive care model might have greater effects in improving HRQoL, specifically the mental-health related outcomes, than the subacute care model. In addition, elders who had received our subacute care intervention improved in HRQoL, specifically physical HRQoL, over time following discharge (Shyu et al., 2010a), and many had reached maximal HRQoL at 12 months following discharge. Thus, we hypothesised that during the year following hip fracture:

(1) Elderly hip-fractured patients who received the comprehensive (CC) and subacute care (SC) models would have better HRQoL, especially for the physically related HRQoL, than those who received usual care (UC), with the comprehensive care group reporting best HRQoL.
(2) Since depressive symptoms were managed only in the CC group, this group would have better mental health outcomes than the SC and UC groups.
(3) The intervention effects for both the CC and SC models would increase after 6 months following hip fracture.

2. Methods

A randomised controlled trial was used to examine the treatment effects of the CC and SC intervention programmes.

2.1. Participants

Patients were included in this study if they met these criteria: (a) age 60 years or older, (b) admitted to hospital for an accidental single-side hip fracture, (c) receiving hip arthroplasty or internal fixation, (d) able to perform full range of motion against gravity and against some or full resistance of the unaffected limb at admission, and have a pre-fracture Chinese Barthel Index (CBI) score $>$ 70, and (e) living in northern Taiwan. Patients were excluded by the following criteria: (a) severely cognitively impaired and completely unable to follow orders (determined by a score $<$ 10 (Perneczky et al., 2006) on the Chinese Mini-Mental State Examination [MMSE; Yip et al., 1992]), or (b) terminally ill. Muscle power was assessed by a trained research nurse who also obtained the pre-fracture CBI score retrospectively from participants or/and caregivers.

Participants (N = 299; 101 in the subacute care group, 99 in the comprehensive care group, and 99 in the usual care group) were recruited from September 2005 to July 2010 (Fig. 1). With a power of 0.80, an alpha of 0.05, and a median effect size of 0.50 (Cohen, 1988), we estimated a sample size of 64 subjects in each group to measure improved physical functioning by the physical function scale of the Medical Outcomes Study Short-Form 36 (SF-36), Taiwan version (Shyu et al., 2004c) within 3 months after discharge (Shyu et al., 2005, 2008b). We estimated the attrition rate from our previous study, in which 25% cases were lost during the first year, and around 35% during the second year (Shyu et al., 2010a). Therefore, we estimated that 100 subjects in each group would be adequate for this study.

2.2. Usual care

Patients are usually sent directly to the hospital emergency room and are cared for by orthopaedists. Consultations for internal medicine care are occasionally made depending on the patient's condition. Physical therapy usually starts on the second or third day without any in-home rehabilitation provided or telephone follow-ups. Patients are encouraged to ambulate with protected weight bearing for 3 months.

2.3. Intervention programmes

For this study, we developed two intervention models: a subacute care model consisting of subacute interventions, and a comprehensive care model consisting of the subacute interventions with added health-maintenance interventions (Shyu et al., 2005, 2008b, 2010a).

2.4. Subacute care model

The subacute care model consisted of geriatric consultation, a continuous rehabilitation programme, and early discharge-planning intervention.

2.4.1. Geriatric consultation

Comprehensive geriatric assessment and medical supervision were provided to detect potential clinical problems and decrease delays before surgery. Patients were initially assessed by the geriatric nurse before surgery to obtain medical and fall histories, current medical conditions, and comorbidities. At the same time, the geriatric nurse conducted a physical examination, physical and cognitive functional assessment, and nutritional status assessment. The geriatric nurse then sent a referral sheet and called the geriatrician. The geriatrician examined high-risk patients who were $\geq$80 years old, at high operative risk, had poor nutritional status, had cognitive impairment or disorientation, or had unstable comorbid conditions. Based on this assessment, the geriatrician then suggested various strategies to the primary surgeon.

2.4.2. Rehabilitation programme

Rehabilitation started on the first day after surgery and continued into the home setting after hospital discharge. Both the inpatient- and in-home rehabilitation programmes contained a hip fracture-oriented intervention and a general intervention to enhance physical fitness. The hip fracture-oriented rehabilitation focused on pain relief; enhancing range of motion, muscle strength and endurance, and proprioception; and balance challenges. The intervention for physical fitness focused on enhancing aerobic capacity, anaerobic capacity, muscle strength and endurance, flexibility, and body composition. During

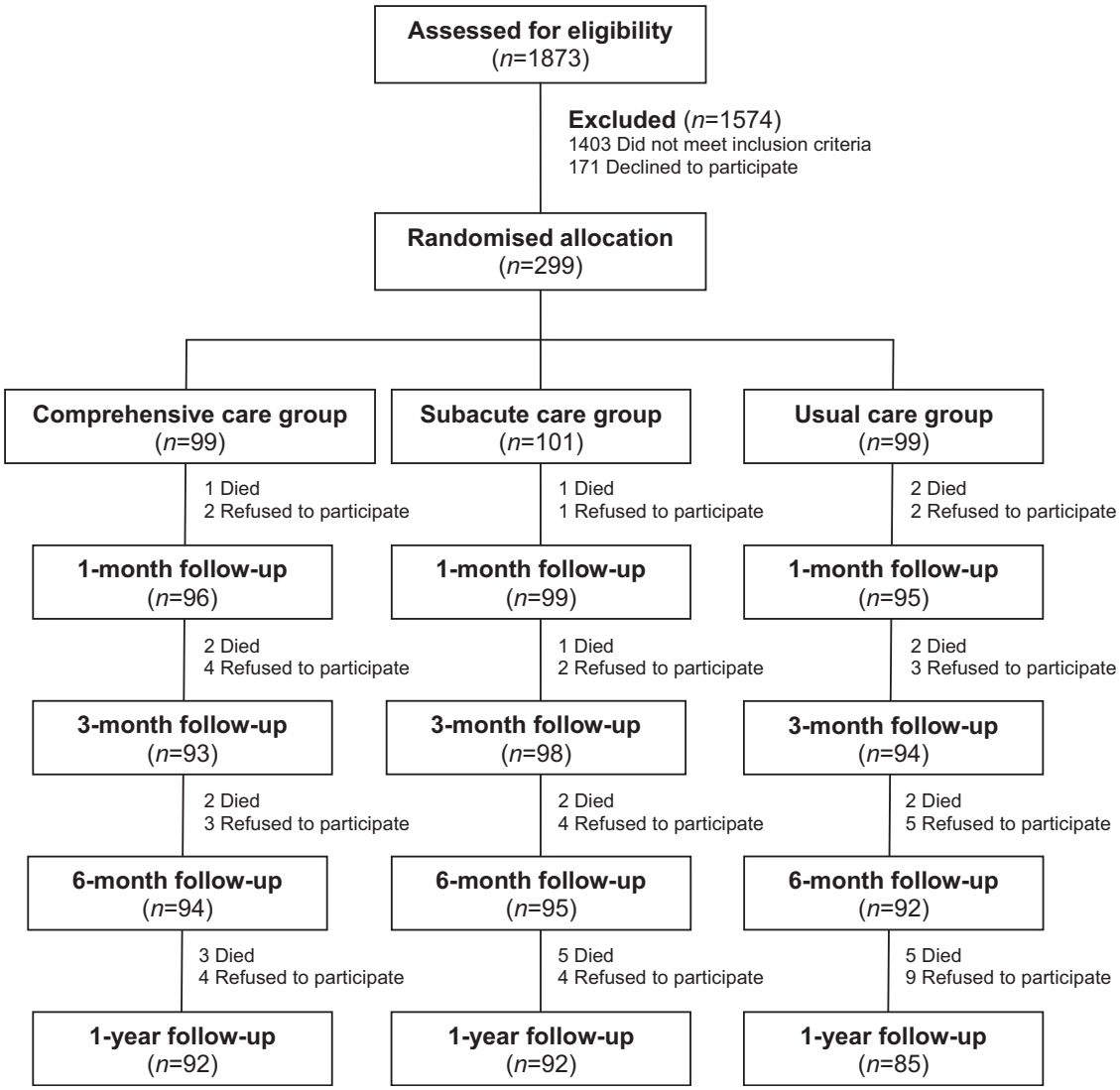

Fig. 1. Flow diagram of the study.

hospitalisation, depending on the patient's condition, the exercise protocol progressed from ankle exercises in bed to knee and hip joint flexion and extension exercises, to walking, and then climbing up and down stairs using a walker. In-hospital rehabilitation included one visit per day by a geriatric nurse and at least two assessments by a physical therapist.

For in-home rehabilitation, the exercise protocol emphasised ankle dorsiflexion with knee extension, isometric full knee extension, progressive muscle-strength training, and ball rolling activities to enhance proprioception. The muscle-strength training programme included ankle pumping exercise, knee extension, gently bouncing jump with knee semiflexed and foot on the floor, which were administered depending on the patient's recovery condition. For both the subacute care and comprehensive care models, subjects received four nursing visits in the first month after discharge, four visits from 2 to 4 months following discharge, and one visit each time from a physical therapist within the first week, third week, and third month after discharge. For in-home rehabilitation, subjects in the subacute care group received on average 7.54 (SD = 0.86) nurse visits and on average 2.51 (SD = 1.04) visits from a physical therapist.

2.4.3. Discharge planning

Geriatric nurses provided structured discharge assessment with home environment assessment, referral, and reminders for clinical follow-up. Discharge assessment included caregiver's competence, resources, family function, elderly patient's self-care ability, elderly patients' and their family caregivers' need for community or long-term care services, and making the necessary referrals. Within 3 days after each patient's discharge, the geriatric nurse visited his/her home to assess its environment and to suggest environmental modifications.

2.5. Comprehensive care model

The comprehensive care model included the components of the subacute care model and health-maintenance interventions to prevent falls, consult on nutrition, and manage depression.

2.5.1. Rehabilitation programme

The comprehensive care group received in-home rehabilitation for 1 year after discharge; thus, they had time to recover enough to perform exercises related to balance challenges and aerobic capacity. The intervention protocol during the hospitalisation and first 4 months following discharge for comprehensive care was the same as for subacute care. In addition, the comprehensive care group received one nursing visit per month from 4 to 6 months following discharge and once every 2 months from 6 to 12 months following discharge, and one physical therapist visit at 6 months following discharge. Subjects in the comprehensive care group received on average 10.91 (SD = 2.12) nurse visits and on average 3.17 (SD = 1.33) physical therapist visits at home.

2.5.2. Fall prevention

During each home visit, nurses and physical therapists systematically assessed participants for specific fall-risk factors (Schoenfelder and Van Why, 1997; Tinetti et al., 1994). For each identified risk factor, the nurse or physical therapist delivered corresponding interventions and evaluated the outcomes.

2.5.3. Nutritional consultation/education

A geriatric nurse assessed patients' nutritional status before discharge and at 1, 3, and 6 months after discharge. Nutritional status was measured by the Mini-Nutritional Assessment (Guigoz et al., 1994; Murphy et al., 2000). The diets of subjects at risk for malnutrition were assessed by a geriatric nurse, and then a geriatrician was consulted. Those identified as malnourished were referred to a dietician. Based on assessments and suggestions of the geriatrician and dietician, a geriatric nurse individually educated subjects and consulted with them to enhance their protein and calorie intake. During each follow-up visit, patients' nutritional status and adherence to dietary suggestions were assessed by the geriatric nurse.

2.5.4. Depression screening and management

A geriatric nurse screened subjects for risk of depression using the Geriatric Depression Scale-short form (Burke et al., 1991; Liu et al., 1998) before discharge and at 1, 3, 6 and 12 months following hospital discharge. For those identified as at risk for depression, a consultation was arranged with a psychiatrist or visit to a psychiatric clinic for diagnosis and management. A geriatric nurse followed up on these subjects' appointment attendance and adherence to their medication regimen and provided individual consultation, emotional support, and enhanced family support engagement. The numbers (percentages) of subjects in the comprehensive care group at risk for depression were 28 (29.5%) before discharge, 30 (33.7%), 19 (22.1%), 19 (23.2%), and 21 (25.9%) at 1, 3, 6, and 12 months after discharge, respectively.

2.6. Measurements

2.6.1. Health-related quality of life (HRQoL)

The SF-36 has 36 items representing eight generic health concepts: physical functioning (PF), role disability due to physical health problems (RP); bodily pain (BP); vitality (energy/fatigue) (VT); general health perceptions (GH); social functioning (SF); role disability due to emotional problems (RE); and general mental health (MH). For each scale, reverse items are recoded, the simple algebraic sums are computed, and the raw scale scores are transformed to a 0–100 scale, with higher scores representing better HRQoL. Finally, physical (PCS) and mental (MCS) component summary scales using norm-based (50, 10) scoring methods were calculated (Ware et al., 1994) based on the norm of a previous study (Tseng et al., 2003). The responsiveness of the SF-36 to assess hip-fracture outcomes has been established (Shyu et al., 2004a; Tidermark et al., 2003). The SF-36 Taiwan version was translated and demonstrated good reliability and validity in a healthy adult sample (Lu et al., 2003; Tseng et al., 2003), and in elderly persons with hip fracture in Taiwan (Shyu et al., 2004b).

2.6.2. Pre-fracture self-care ability

The pre-fracture self-care ability of hip-fractured elders was retrospectively assessed using the Chinese Barthel Index (CBI), which measures dependencies in eating, transferring, grooming, toileting, bathing, walking, climbing stairs, dressing, as well as bowel and bladder control (Chen et al., 1995). The CBI, with scores ranging from 0 to 100, has been shown to have satisfactory reliability and validity for assessing Taiwanese elders in long-term care (Chen et al., 1995) and those with hip fracture (Shyu et al., 2004c, 2008a).

2.7. Ethical considerations

This study was in compliance with the Helsinki Declaration and local legislation. Before data were collected, the study was approved for human subject research by the study hospital (Chang Gung Medical Foundation, Institutional Review Board; approval number: 94-422C). Participants gave informed consent to participate in the study.

2.8. Procedures

Subjects were recruited from the emergency room by research assistants. Those who agreed to participate were randomly assigned before surgery to either the subacute care group, comprehensive care group, or usual care group. The randomisation sequence was generated by a throw of dice by a neutral person not involved in delivering interventions and assessing outcomes. The participants only knew that they were in a study but were blinded to which intervention group they were in. Subjects in the subacute care group received usual care plus the subacute

care intervention programme. Subjects in the comprehensive care group received usual care plus the comprehensive care intervention programme. Subjects in the control group received only usual care plus regular social contact provided by a research nurse at the same time that the experimental groups received their interventions. All subjects were assessed for pre-fracture performance of activities of daily life (ADLs) before surgery and assessed for HRQoL outcome variables at 1, 3, 6, and 12 months after discharge.

2.9. Statistical analysis

Analyses were done under an intention-to-treat principle. The analysis using on-protocol subjects revealed similar results as using the intention-to-treat principle. Differences in baseline characteristics, including pre-fracture self-care ability among the subacute care, comprehensive care and usual care groups, were assessed by one-way ANOVA or chi-square tests, with the significance level set to 0.05.

We analysed changes in outcome variables using hierarchical linear models (Raudenbush and Bryk, 2002). A series of multilevel linear models using usual hospital care (usual group) as the reference were estimated. We centred time at 3, 6, and 12 months after discharge to minimise the possibility of multicollinearity, to test the hypothesis regarding treatment effects at different time points when we evaluated non-linear function of changes with time, and to understand differences among three groups over time. For each outcome variable, we accounted for attrition (both subjects who died and those who dropped out for other reasons).

3. Results

3.1. Baseline participant characteristics

At the end of 12 months, 92 subjects remained in the comprehensive care group, 92 in the subacute care group, and 85 in the usual care group. During the 12-month follow-up, 13 subjects died (3 in the comprehensive care group, 5 in the subacute care group, and 5 in the usual care group), and 17 subjects declined to participate. No significant differences were found between those who completed all follow-ups ($n = 269$) and those who did not ($n = 30$).

Of the 299 participants among three groups in the final sample, the majority was female (59.6–67.3%), with an average age of 76.17–76.91 years. Around half (48.5–57.6%) were married, a large percentage (37.6–52.5%) was illiterate, 50.5–62.4% had a femoral neck fracture, 35.4–48.5% had an intertrochanteric fracture, 55.4–68.7% received internal fixation, and 31.3–44.6% received arthroplasty. Participants' mean CBI score before fracture was 96.16–97.23, representing independence in performing ADLs, and 92.9–96% could walk independently before the fracture. The mean number of comorbidities ranged from 1.80 to 2.0, the American Society of Anesthesiologists (ASA) rating ranged from 2.51 to 2.63, and time from admission to operation ranged from 2.16 to 2.30 days. The average length of hospital stay of the three groups ranged from 7.93 to 8.47. The two experimental groups and control group did not differ significantly in age, gender, marital status, education background, number of co-morbidities, ASA rating, type of fracture and surgery, length of hospital stay, time from admission to surgery, pre-fracture ADL performance, and pre-fracture independence in walking ability. Each domain and summary component scores for HRQoL by three care groups at each time point are shown in Table 1.

3.2. Comparison of outcome variables

3.2.1. Physical functioning

The comprehensive care group and subacute care group had significantly better physical functioning (PF) than the usual care group. The estimated mean PF was 10.33 points more for comprehensive care ($b = 10.33$, $p < 0.05$) and 10.93 points more for subacute care ($b = 10.93$, $p < 0.05$) than usual care when time was centred at 12 months following discharge (Table 3). The intervention effects for PF increased over time, especially from 6 to 12 months following discharge (Fig. 2).

3.2.2. Role physical

The comprehensive care and subacute care groups had better role physical (RP) than the usual care group from 3 to 12 months following discharge. When centring time at 3 months (Table 2), the estimated mean role physical score for the comprehensive care group was 14.63 ($b = 14.63$, $p < 0.01$) points more than that for the usual care at 3 months following discharge. The estimated mean RP scores for comprehensive care and subacute care were 24.77($b = 24.77$, $p < 0.01$) and 33.41 ($b = 33.41$, $p < 0.001$) points more, respectively, than the RP score for the usual care group at 12 months following discharge (Table 3).

As shown in Fig. 2, RP scores for the comprehensive and usual care groups were much higher than those for the usual care group, and the difference was maximal at 12 months following discharge. RP scores for the subacute care group did not differ from those of the usual care group during the first 3 months, but the difference increased dramatically after 6 months and reached a maximum at 12 months following discharge.

3.2.3. Bodily pain

The comprehensive care group had poorer role limitation due to bodily pain (BP) than the usual care group during the first 6 months following discharge. When centring time at 3 months (Table 2), the comprehensive care group had poorer BP ($b = -9.31$, $p < 0.01$), indicated by 9.31 points less than the usual care group. As shown in Fig. 2, the usual care group had better health outcomes in BP than the comprehensive care group during the first 6 months, and this difference decreased from 6 to 12 months following discharge. The subacute care group had similar health outcomes in bodily pain as the usual care group.

3.2.4. General health

The comprehensive care group had better general health (GH) than the usual care group at 12 months

Table 1
Health-related quality of life by treatment group.

Dimension of HRQoL	Group			*F*
	Comprehensive care ($n = 99$)	Subacute care ($n = 101$)	Usual care ($n = 99$)	
PF, mean ± *SD*				
Month 1	16.33 ± 18.88	14.74 ± 15.16	11.81 ± 16.45	1.68
Month 3	40.11 ± 29.26	40.43 ± 28.49	34.24 ± 27.42	1.31
Month 6	54.76 ± 28.75	57.67 ± 30.21	50.00 ± 31.23	1.40
Month 12	64.45 ± 28.60	66.85 ± 27.74	55.86 ± 31.91	2.97
RP, mean ± *SD*				
Month 1	16.11 ± 29.58	6.44 ± 23.18	4.44 ± 17.40	6.18**
Month 3	31.60 ± 37.44	24.19 ± 40.78	20.40 ± 34.84	1.98
Month 6	49.40 ± 43.21	45.93 ± 46.15	30.18 ± 40.20	4.64*
Month 12	62.19 ± 42.71	71.60 ± 42.71	39.52 ± 45.89	10.89***
BP, mean ± *SD*				
Month 1	62.72 ± 22.26	70.92 ± 17.58	69.81 ± 24.09	3.97*
Month 3	69.75 ± 23.32	80.63 ± 19.93	79.03 ± 21.54	6.53**
Month 6	72.95 ± 26.54	79.69 ± 22.97	84.59 ± 21.99	4.16*
Month 12	80.98 ± 21.90	83.00 ± 19.09	85.69 ± 21.14	1.01
GH, mean ± *SD*				
Month 1	53.23 ± 26.65	54.71 ± 20.79	52.27 ± 24.35	0.25
Month 3	61.93 ± 25.68	57.82 ± 20.63	54.27 ± 23.26	2.36
Month 6	58.79 ± 24.50	58.75 ± 22.68	54.85 ± 24.43	0.74
Month 12	60.66 ± 24.89	56.09 ± 24.98	52.66 ± 28.07	1.86
VT, mean ± *SD*				
Month 1	65.55 ± 20.62	67.73 ± 19.32	67.14 ± 23.88	0.26
Month 3	72.24 ± 18.70	75.54 ± 15.30	72.64 ± 20.40	0.88
Month 6	72.85 ± 19.86	75.75 ± 16.36	71.15 ± 23.29	1.14
Month 12	72.43 ± 22.69	75.80 ± 18.93	70.13 ± 22.54	1.39
SF, mean ± *SD*				
Month 1	48.75 ± 32.94	44.40 ± 24.25	51.78 ± 29.55	1.53
Month 3	59.77 ± 29.06	64.53 ± 24.81	58.47 ± 29.37	1.19
Month 6	73.51 ± 26.49	77.18 ± 23.10	71.91 ± 26.25	0.96
Month 12	80.40 ± 23.95	85.64 ± 19.87	76.01 ± 26.47	3.27*
RE, mean ± *SD*				
Month 1	75.65 ± 39.81	91.06 ± 27.43	75.18 ± 41.37	5.78**
Month 3	83.14 ± 33.67	92.83 ± 24.49	84.29 ± 33.65	2.69
Month 6	87.30 ± 31.00	96.12 ± 16.50	87.39 ± 31.70	2.95
Month 12	91.46 ± 26.08	94.71 ± 21.25	90.22 ± 27.82	0.68
MH, mean ± *SD*				
Month 1	69.42 ± 22.51	69.41 ± 18.59	68.52 ± 22.28	0.05
Month 3	75.21 ± 21.19	75.33 ± 17.70	74.52 ± 19.32	0.04
Month 6	75.61 ± 22.73	75.48 ± 15.64	74.91 ± 21.40	0.03
Month 12	78.22 ± 21.41	75.15 ± 19.68	71.25 ± 22.98	2.08
PCS, mean ± *SD*				
Month 1	46.08 ± 7.05	46.91 ± 5.08	44.58 ± 5.43	1.74
Month 3	53.42 ± 9.41	54.24 ± 9.62	51.72 ± 9.06	1.63
Month 6	59.47 ± 10.01	60.58 ± 11.00	57.70 ± 10.12	1.61
Month 12	64.25 ± 11.19	65.92 ± 9.69	60.61 ± 11.19	4.91**
MCS, mean ± *SD*				
Month 1	54.51 ± 10.35	55.53 ± 8.21	55.86 ± 10.55	0.47
Month 3	55.07 ± 9.12	56.11 ± 7.69	55.43 ± 8.72	0.33
Month 6	53.13 ± 9.53	53.79 ± 7.07	53.68 ± 10.04	0.13
Month 12	52.72 ± 10.70	51.50 ± 8.11	51.64 ± 9.64	0.39

BP, bodily pain; HRQoL, Health-related quality of life; GH, general health perceptions; MCS, mental component summary score; MH, general mental health; PCS, physical component summary score; PF, physical functioning; RE, role disability due to emotional problems; RP, role disability due to physical health problems; SF, social functioning; VT, vitality (energy/fatigue).

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

following discharge. When centring time at 12 months (Table 3), the comprehensive care group had better GH ($b = 8.35$, $p < 0.05$), indicated by 8.35 points more than the usual care group. As seen in Fig. 2, the differences among the three groups were small, but the comprehensive care group had better GH than the subacute care and usual care groups, with the difference increasing over time, becoming more obvious after 6 months, and appearing largest at 12 months following discharge.

3.2.5. Vitality

The subacute care group had better vitality than the usual care group at 12 months following discharge. When centring time at 12 months (Table 3), the subacute care group had better vitality ($b = 6.48$, $p < 0.05$), indicated by 6.48 points more than the usual care group. As seen in Fig. 2, the differences among the three groups were small, but the subacute care group had better VT than the comprehensive care and usual care

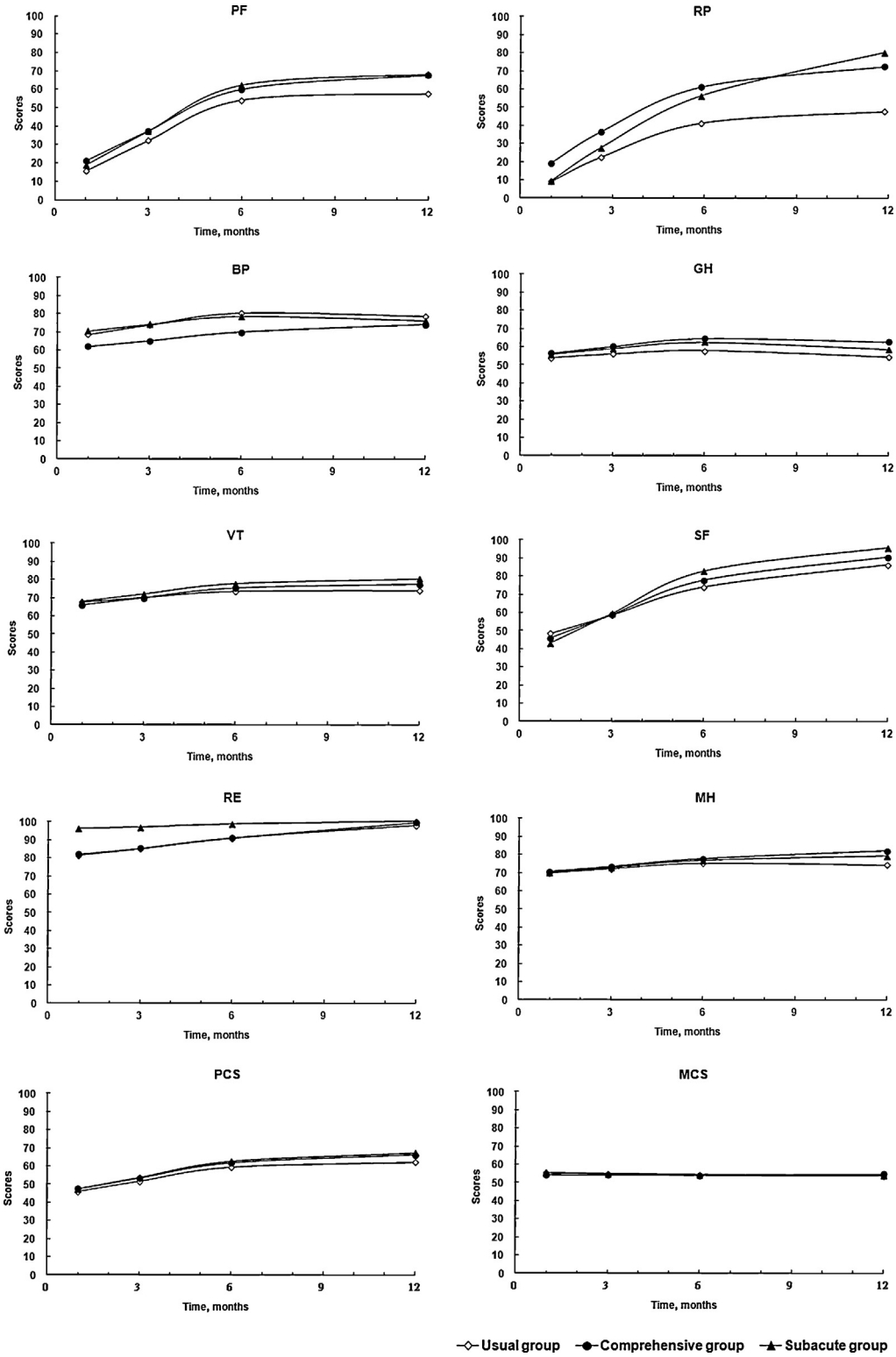

Fig. 2. Postoperative HRQoL over time by treatment group. BP = bodily pain; GH = general health perceptions; MH = general mental health; PF = physical functioning; RE = role disability due to emotional problems; RP = role disability due to physical health problems; SF = social functioning; VT = vitality (energy/fatigue); PCS = physical component summary score; MCS = mental component summary score.

Table 2
Treatment effects on postoperative health-related quality of life for elders with hip fracture (time centred at 3 months).

Outcome variable	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Intercept	34.69***	25.20***	74.87***	55.64***	69.95***	60.37***	85.34***	72.24***	52.51***	54.35***
Comprehensive care group	5.26	14.63**	−9.31**	4.60	−0.06	0.74	0.34	1.32	1.87	−0.57
Subacute care group	5.61	6.45	−0.22	3.42	2.13	1.96	11.48**	0.82	2.22*	0.23
Linear	8.32***	6.91***	2.65***	0.85**	1.14***	5.42***	1.94**	1.20***	2.91***	−0.43**
Comprehensive care group	0.03	2.10	−0.98	0.93	0.72	1.35	−0.16	0.22	0.11	0.32
Subacute care group	1.09	3.06*	−0.86	0.67	0.89	3.14**	−1.58	0.17	0.39	0.21
Quadratic	−0.68***	−0.56**	−0.28*	−0.13	−0.08	−0.26**	−0.03	−0.12	−0.22***	0.04
Comprehensive care group	0.06	−0.11	0.17	−0.06	−0.04	−0.11	0.03	0.06	0.01	−0.01
Subacute care group	−0.06	−0.01	0.07	−0.07	−0.05	−0.26*	0.10	0.04	−0.01	−0.02
Random effect										
Intercept	413.38***	655.03***	226.20***	333.26***	217.60***	428.44***	498.49***	292.27***	46.92***	55.29***
Linear slope	15.19***	41.68***	15.22***	10.59***	7.83***	24.11***	41.93***	8.36***	1.97***	2.43***
Quadratic slope	0.13***	0.53***	0.18***	0.12***	0.04*	0.16**	0.30***	0.09***	0.02***	0.02***

The model was calculated controlling for attrition and pre-fracture functional status.
Reference group: Usual care group.
BP, bodily pain; GH, general health perceptions; MCS, mental component summary score; MH, general mental health; PCS, physical component summary score; PF, physical functioning; RE, role disability due to emotional problems; RP, role disability due to physical health problems; SF, social functioning; VT, vitality (energy/fatigue).
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

groups, becoming more obvious after 6 months following discharge.

3.2.6. Social function

The subacute care group had better social function (SF) than the usual care group from 6 to 12 months following discharge. When centring time at 12 months (Table 3), the subacute care group had better SF ($b = 9.33$, $p < 0.05$), indicated by 9.33 points more in SF than those who received usual care. As shown in Fig. 2, the subacute care group had better social function than the comprehensive care and usual care groups, and this difference increased over time after 3 months following discharge.

3.2.7. Role emotion

The subacute care group had better role emotion (RE) than the usual care group only during the first 6 months following discharge. When centring time at 3 months (Table 2), the subacute care group had better RE ($b = 11.48$, $p < 0.01$), indicated by 11.48 points more in RE than those who received usual care. In Fig. 2, the subacute care group had better role emotion than both the comprehensive and usual care groups, but this difference decreased over time.

3.2.8. Mental health

The comprehensive care group had better mental health (MH) than the usual care group only at 12 months following discharge. When centring time at 12 months

Table 3
Treatment effects on postoperative health-related quality of life for elders with hip fracture (time centred at 12 months).

Outcome variable	PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Intercept	54.58***	42.08***	76.33***	52.89***	74.04***	88.47***	100.37***	73.72***	60.99***	53.98***
Comprehensive care group	10.33*	24.77**	−4.52	8.35*	3.33	4.14	1.67	7.93*	4.10*	1.27
Subacute care group	10.93*	33.41***	−2.63	4.19	6.48*	9.33*	5.40	5.24	5.35**	0.41
Linear	−3.91**	−3.16	−2.33	−1.46	−0.23	0.82	1.40	−0.87	−1.03	0.35
Comprehensive care group	1.10	0.16	2.04	−0.10	0.03	−0.60	0.46	1.25	0.38	0.09
Subacute care group	0.09	2.93	0.32	−0.50	0.07	−1.50	0.23	0.81	0.30	−0.16
Quadratic	−0.68***	−0.56**	−0.28*	−0.13	−0.08	−0.26**	−0.03	−0.12	−0.22***	0.04
Comprehensive care group	0.06	−0.11	0.17	−0.06	−0.04	−0.11	0.03	0.06	0.01	−0.01
Subacute care group	−0.06	−0.01	0.07	−0.07	−0.05	−0.26*	0.10	0.04	−0.01	−0.02
Random effect										
Intercept	622.86***	1332.98***	194.98***	505.36***	336.43***	305.43***	281.75***	367.66***	84.59***	75.38***
Linear slope	10.43**	66.31***	16.18**	12.31***	3.48	7.19	12.14	8.73***	2.58***	2.11***
Quadratic slope	0.13***	0.53***	0.18***	0.12***	0.05*	0.16***	0.30***	0.09***	0.02***	0.02***

The model was calculated controlling for attrition and pre-fracture functional status.
Reference group: Usual care group.
BP, bodily pain; GH, general health perceptions; MCS, mental component summary score; MH, general mental health; PCS, physical component summary score; PF, physical functioning; RE, role disability due to emotional problems; RP, role disability due to physical health problems; SF, social functioning; VT, vitality (energy/fatigue).
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

(Table 3), the comprehensive care group had better MH ($b = 7.93$, $p < 0.05$), indicated by 7.93 points more in MH than those who received usual care. In Fig. 2, the differences among the three groups were very small, but the comprehensive care group had better MH than both the subacute care and usual care groups, with the difference more obvious at 12 months following discharge.

3.2.9. PCS and MCS

The comprehensive care and subacute care groups had significantly better physical component summary (PCS) scores than the usual care group. The estimated PCS for the subacute care group was 2.22 ($b = 2.22$, $p < 0.05$) points more than that for the usual care group when time was centred at 3 months following discharge (Table 2). The estimated mean PCS was 4.10 points more for the comprehensive care group ($b = 4.10$, $p < 0.05$) and 5.35 points more for the subacute care group ($b = 5.35$, $p < 0.01$) than the usual care group when time was centred at 12 months following discharge (Table 3). The intervention effects for PCS increased over time, especially from 6 to 12 months following discharge (Fig. 2). No significant differences were found in MCS among the three intervention groups.

In summary, both the comprehensive care and subacute care groups reported better HRQoL in physical-related function (PF, RP and PCS) than the usual care group. The comprehensive care group also had better GH and better MH at the end of the first year than the usual care group. At the same time, the subacute care group had better health outcomes (including VT and SF) relating to both physical and mental health than the usual care group. However, no dimensions of HRQoL differed significantly between the comprehensive care and subacute care groups at 12 months following discharge. Therefore, we can only conclude that both the comprehensive care and subacute care interventions more effectively improved HRQoL than usual care. These results partially support the first hypothesis and support the second hypothesis, i.e. the comprehensive care group would have better MH than the subacute and usual care groups.

These results mostly support the third hypothesis that the intervention effects would increase after 6 months following hip fracture. For most dimensions of HRQoL, the intervention effects for both the comprehensive and subacute care groups increased over time, specifically after 6 months following hip fracture, and reached a maximum at 12 months following discharge.

4. Discussion

The benefits of both the comprehensive and subacute care intervention on HRQoL lasted throughout the first year after discharge. Similar to these findings, quality of life has been shown to improve after intervention programmes for hip-fractured elders (Shyu et al., 2010b). Our study further found that comprehensive care combining both subacute care and health-maintenance interventions improved physical function, role physical, general health, and mental health, and that subacute care improved physical health, role physical, vitality, and social function during the first year following hip-fracture surgery.

Hip fracture in the elderly has been associated with long-term poor HRQoL, as well as increased morbidity and mortality (Pande et al., 2006; Rohde et al., 2010). In fact, HRQoL in patients with hip fracture predicted mortality for over 4 years after discharge (Kroenke et al., 2008; Peterson et al., 2008), and worse mental HRQoL in this population was predicted by co morbidity (Rohde et al., 2010). In terms of clinical significance, a minimally important difference (MID) of 5 is suggested for the SF-36 (Bjorner et al., 2007; Walters, 2004). The differences in GH and MH between the comprehensive care and usual care groups, and in VT and SF between the subacute care and usual care groups at 12 months following discharge were all greater than 6, indicating clinical significance. In particular, the differences in PF between the comprehensive care and usual care groups (10.33) and between the subacute care and usual care groups (10.93) at 12 months following discharge were greater than 10, and the differences in RP were greater than 20 (comprehensive care group = 24.77, subacute care group = 33.41), indicating the large magnitude of the interventions' positive effect. Consistent with a prior report (Shyu et al., 2004a), the physical functioning dimension of hip-fractured elders' HRQoL was poorer after discharge than the mental/social dimensions. Therefore, physical functioning might have a greater potential to be improved by treatment (Shyu et al., 2010b).

The comprehensive care group had better mental health as we hypothesised. This outcome might be due to that group systematically receiving an intervention to detect and manage depressive symptoms. The Mental Health Scale of the SF-36 has been found to useful in screening for psychiatric disorders, including depression, thus the effects of management of depressive symptoms in the comprehensive care group might be able to improve the score of the MH in current study (Silveira et al., 2005).

Contrary to our expectations, patients who received comprehensive care had more role limitation due to bodily pain during the first 6 months following discharge, and this difference disappeared at 12 months following discharge. This finding might be due to the rehabilitation programme, which emphasised enhancing fitness, causing patients extra pain (Liu and Latham, 2009). This explanation is consistent with pain decreasing from 6 to 12 months following discharge, when physical condition would have improved. The location and characteristics of pain need to be explored in future studies.

For the time trends in changes, the intervention effects for both the comprehensive and subacute care groups, especially for physical-related outcomes, increased after 6 months and reached a maximum at 12 months following discharge, as previously reported (Shyu et al., 2010a). This trend might be due to patterns of recovery differing by area of function, with lower extremities taking almost a year for function to improve (Magaziner et al., 2000). Since many of the physical-related outcomes were specific tasks involving the lower extremities, the intervention effects might not be observed until 1 year after surgery.

4.1. Limitations

Several limitations were found in this study. First, the study design was single blinded only to subjects. This design was due to the technical difficulty of blinding assessors who would know right away from conversations with subjects which group they belonged to. To minimise the potential influence of bias, the personnel delivering the intervention and assessing outcomes were intentionally assigned different research duties. Also, the generalisability of the study results might have been limited by sample selection bias in that our study criteria excluded elders with severe cognitive impairment and weak muscle power. The study sample contained more female than male participants. However, this patient profile is similar to that found in populations of older persons with hip fracture (Allegrante et al., 2007; Rohde et al., 2010). Thus, the interventions developed in this study could be applied to the population of older persons with hip fracture.

5. Conclusion

In summary, our subacute care and comprehensive care programmes benefited elderly persons with hip fracture in Taiwan by improving their HRQoL throughout the first year after discharge. The subacute care programme included geriatric hip-fracture rehabilitation and discharge-support components, and the comprehensive care programme included not only components of the subacute care programme, but also nutritional consultation, depression management, and fall prevention. The treatment effects increased over the 1-year period following discharge, particularly from 6 months onward, and reached a maximum at 12 months following discharge. Our intervention programmes were not specific to Chinese culture or ethnicity, so they can be applied in their current form beyond Chinese ethnic groups.

Future studies can examine the effects of the intervention programmes in other ethnic groups, explore the treatment effects of the intervention on the relationships among HRQoL, morbidity and mortality following hip fracture, and conduct a cost–benefit analysis of the costs associated with the intervention programmes.

Conflict of interest

None declared.

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Ethical approval

Chang Gung Medical Foundation, Institutional Review Board (approval number: 94-422C).

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