Poor functional recovery after a critical illness

a longitudinal study

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ORIGINAL REPORT

POOR FUNCTIONAL RECOVERY AFTER A CRITICAL ILLNESS: A LONGITUDINAL STUDY

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Objective: **To determine the time course of functional health status, and to inventory impairments in body functions, limitations in activities, and restrictions in participation after critical illness.**

Design: **Prospective observational cohort study.**

Setting: **Mixed medical and surgical closed format; intensive care unit of an academic medical hospital.**

Patients: **Consecutive patients over a period of 3 months who were ventilated in the intensive care unit for more than 48 h ($n = 116$).**

Methods: **Functional health status was assessed 3, 6 and 12 months after discharge from the intensive care unit using the Sickness Impact Profile 68. Impairments in function, limitations in activities, and restrictions in participation, classified according to the International Classification of Functioning, Disability, and Health (ICF), were evaluated after 3 and 12 months.**

Results: **Due to a high mortality rate (48%) and poor health conditions, data could not be obtained from all participants at all measurement points. Physical functioning and social behaviour improved predominantly within the first 6 months, while impaired psychological functioning remained unchanged within one year after discharge from the intensive care unit. After one year, 69% of patients were still restricted in performing daily activities and only 50% had resumed work.**

Conclusion: **The extent and severity of lasting intensive care unit-related disability necessitates the development of multidisciplinary after-care to improve health status, functional independence and return to work.**

Key words: intensive care, convalescence, activities of daily living, rehabilitation, longitudinal study.

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INTRODUCTION

Millions of individuals are admitted to intensive care units (ICU) each year, and advances in the treatment of these critically ill patients have considerably increased the survival rate. Having survived the ICU, an increasing number of these patients now face the burden of long-term critical illness (1). Follow-up care has been recommended to improve outcome in ICU survivors. However, structured follow-up care is currently rare and the optimal structure, timing, and content have not been established (2, 3). Optimal follow-up care of ICU survivors, however, awaits a systematic evaluation of their long-term impairments and restrictions in daily functioning.

Follow-up studies have shown that, after ICU treatment, quality of life is reduced (4–8), daily functioning is restricted (9, 10), healthcare medical costs are increased (7), and return to work is impeded (11, 12). Moreover, a large variety of physical and psychological impairments and restrictions in ICU survivors have been reported. These include, muscle weakness, limited walking capacity, cognitive dysfunction, symptoms of post-traumatic stress disorder (PTSD), and depression and anxiety (11–15). In our previous study comprising 254 consecutive survivors of ICU who were ventilated for more than 48 h, 54% were still restricted in performing their daily activities after one year; and 60% of patients who were restricted in their activities of daily living had severe functional limitations (10).

If we can develop early interdisciplinary rehabilitation follow-up treatment for these patients, we may be able to reduce, or even prevent, their severe restrictions in physical and psychological functioning. This, in turn, requires a thorough understanding of the course of recovery and the identification of rehabilitation needs.

The purpose of this prospective longitudinal study was therefore to study in detail the course of physical and psychological recovery after ICU stay, and the prevalence of clinical sequelae complicating functional recovery during the first year following critical illness.

MATERIAL AND METHODS

Study population

All adult patients (age ≥ 18 years), who were admitted to the 28-bed, mixed medical and surgical closed-format ICU of the Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands between 1 June and 31 August 2005, and who had received mechanical ventilation for more than 48 h, were eligible for participation in the study. Patients with insufficient knowledge of the Dutch language were excluded.

Patients who are discharged from the ICU do not receive standardized ICU aftercare. The usual care after hospital discharge may vary from none, or physical therapy, to multidisciplinary rehabilitation therapy consisting of several combined interventions by a rehabilitation physician, physical therapist, occupational therapist, psychologist, and/or social worker.

The Ethical Review Board of the Academic Medical Center waived the need for informed consent because of the non-interventional nature of the study.

Outcome measures

Three, 6, and 12 months after discharge from the ICU, the Sickness Impact Profile 68 (SIP68) as a measure for functional health status and a self-composed questionnaire that provides insight into the use of rehabilitation resources was sent to all participants. At 3 and 12 months after discharge from the ICU, participants were invited for a follow-up visit to the hospital, to inventory the presence of ICU-related sequelae using a self-composed questionnaire.

The SIP68 is a validated short version of the 136-item version of the SIP and evaluates health-related functional status by assessing the behavioural effects of illness (16–18). The SIP68 consists of 6 domains: somatic autonomy, mobility control, psychic autonomy and communication, social behaviour, emotional stability, and mobility range. The separate domain scores, a total SIP68 score, or 3 dimension scores (physical, psychosocial, and social) can be calculated, with scores ranging from 0 (no functional limitations) to 100 (severe functional limitations). The cut-off point as recommended by Bosscha et al. (19) was applied, by which patients with a score of 0–10 are classified as doing well in daily life, scores of 10–20 indicate mild health-related dysfunctions, and scores > 20 indicate clear disability in performing daily life activities (i.e. poor functional status). In addition to the SIP68, a questionnaire was administered that included questions regarding what post-discharge rehabilitation resources were provided, encompassing treatment from a rehabilitation physician or allied health professionals (i.e. psychologist, physical or occupational therapist, social worker).

Furthermore, participants were invited for a follow-up visit to the hospital at 3 and 12 months after discharge from the ICU to inventory impairments in functions, limitations in activities, and restrictions in participation (20).

Patients were asked about the presence of impairments in sensory, neuromusculoskeletal, and movement-related functions; limitations in activities; and restrictions in participation. For this purpose, a list of a wide range of symptoms and functional problems, which were identified in a previous study in patients following ICU and classified according to the International Classification of Functioning, Disability, and Health (ICF) (20), was composed (10) (Appendix I). Information on patient characteristics was obtained from medical records and the computerized hospital database and included age, gender, severity of illness at admission to ICU (Acute Physiology and Chronic Health Evaluation, APACHE II, score) (21), length of stay (LOS) at the ICU and ICU admission diagnosis category. The APACHE II classification measures the severity of disease for patients admitted to an ICU and is calculated from 12 routine physiological measurements (blood pressure, body temperature, heart rate, etc.) during the first 24 h after admission, information about previous health status and some information obtained at admission (such as age). Scores range from 0 to 71; higher scores imply a more severe disease and a higher risk of death (21).

Physical functioning prior to admission to ICU was assessed with the physical dimension of the SIP68 one week after ICU discharge, the patient was asked to mark the statement that best described his or her state of health in the 4 weeks prior to admission to ICU.

Data analysis

Baseline data and outcome measures were analysed with descriptive statistics. The data are expressed as means and standard deviations (SD). If the distribution was skewed, then medians and interquartile ranges are presented. Standard errors were calculated for the point estimates of the proportion of patients with impairments, and restrictions in activities and participation. Generalized estimating equation (GEE) analysis was used to study the time course of changes of the SIP68 during the first year after discharge from the ICU. GEE analysis is a linear regression analysis that takes into account the dependence of the observations within one patient, and allows all longitudinal data to be used, including the data on incomplete cases. The descriptive, parametric, and non-parametric statistics analyses were performed in SPSS 12.0 (SPSS Inc, Chicago, IL, USA). GEE analysis was performed with STATA (version 7).

RESULTS

Of the 116 patients ventilated for more than 48 h, 47 survivors were included (43 patients died, 20 were lost to follow-up because they were transferred to another hospital shortly after discharge from the ICU, 4 refused participation, and 2 were excluded). As a result of death or poor health during the study period, data could not always be obtained from all patients. The populations evaluated at 3, 6 and 12 months consist of 3 different subsets of patients. Consequently, complete data including all follow-up measurements of the primary outcome SIP68 was obtained from 21 of the 47 patients. The one year mortality rate of patients who were ventilated for more than 48 h was 48%. During the follow-up period, the response rate among the survivors increased from 62% (29 patients of 47) after 3 months, to 74% (29 patients of 39) after 6 months, and 88% (30 patients of 34) after 12 months. Non-response was primarily due to poor health. Of the 29 patients who returned the questionnaires after 3 months, 17 attended the follow-up appointment. After 12 months, 30 patients returned the questionnaire, of whom 22 attended the follow-up appointment. Fig. 1 shows the number of survivors, exclusion, and the response rate during follow-up. The characteristics of the study population are shown in Table I.

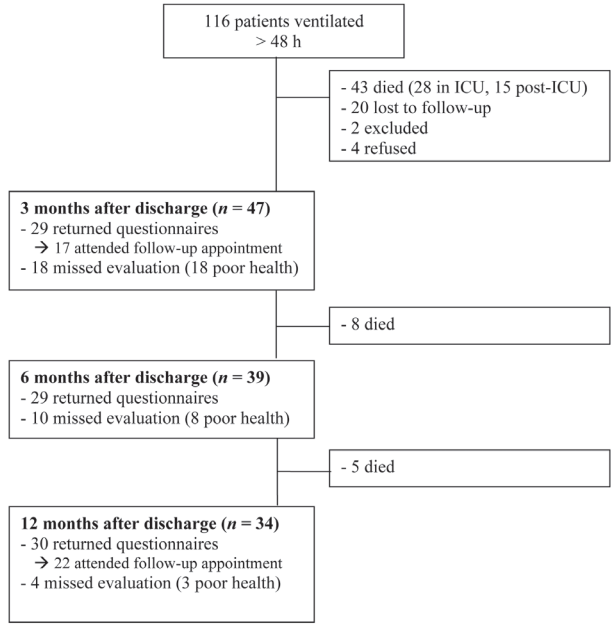

Fig. 1. Flow diagram of study participants (ICU: intensive care unit).

Table I. *Patient characteristics*

	3 months after discharge from ICU			6 months after discharge from ICU	12 months after discharge from ICU		
	Survivors *n*=47	SIP68 *n*=29	Follow-up appointment *n*=17	SIP68 *n*=29	Survivors *n*=34	SIP68 *n*=30	Follow-up appointment *n*=22
Age, years, mean (SD)	58 (15)	56 (15)	55 (14)	58 (14)	56 (16)	57 (16)	54 (16)
Range	20–82	20–76	25–76	20–79	20–79	20–79	20–79
Gender, male, %	62	69	65	66	62	60	59
ICU stay, days							
Median (IQR)	9 (6–14)	8 (6–12)	8 (6–11)	10 (7–18)	9 (6–15)	10 (7–18)	9 (7–13)
Mean (SD)	12 (9)	11 (6)	9 (7)	13 (9)	11 (7)	12 (7)	11 (7)
Apache II							
Mean (SD)	17 (7)	17 (7)	15 (7)	16 (7)	16 (7)	16 (7)	15 (7)
Admission diagnosis, % (*n*)							
Medical*	43 (20)	48 (14)	47 (8)	48 (14)	35 (12)	37 (11)	36 (8)
Unscheduled surgery	30 (14)	17 (5)	12 (2)	21 (6)	30 (10)	27 (8)	23 (5)
Scheduled surgery	28 (11)	35 (10)	41 (7)	31 (9)	35 (12)	37 (11)	41 (9)
SIP Phys prior ICU							
Median (IQR)†	0 (0–6)	0 (0–9)	5 (0–13)	0 (0–10)	0 (0–6)	0 (0–8)	0 (0–8)

*Medical: no surgery in past 7 days prior to ICU admission.
†Score on SIP Physical dimension indicating the level of functioning 4 weeks prior to ICU admission (high score indicating poor functioning).
Apache II: Acute Physiology and chronic Health Evaluation; ICU: intensive care unit; IQR: interquartile range; SD: standard deviation; SIP: sickness impact profile.

There were no significant differences in baseline characteristics (age, gender, LOS in the ICU, APACHE, admission diagnosis category, and SIP physical score prior to ICU) between the non-respondents and the patients who returned the questionnaire, or those who attended the follow-up appointment.

SIP68

The overall SIP68 score decreased over time, indicating functional improvement. This time course was also found for the physical and social dimensions (SIP68 total β=–1, (CI –1.65 to –0.35), $p=0.002$; SIP68 physical β=–1.38, (CI –2.11 to –0.66), $p=0.000$; SIP68 social β=–1.75, (CI –3.19 to –0.29), $p=0.015$). No significant effect of time was found on the psychological dimension (SIP68 psychological β=0.22, (CI –0.44 to 0.88), $p=0.500$) (Fig. 2).

Of the patients who were evaluated after 3 months, 25 (86%) had restrictions in daily functioning (SIP68 >10), of whom 18 (62%) had severe limitations (SIP68 >20). After 6 months, there were restrictions in 24 (83%) patients, of whom 14 (48%) were severely limited. Thirty of 34 survivors were assessed 12 months after discharge from the ICU. Twenty patients (69%) were still restricted in performing daily activities, of whom 15 had severe limitations (Table II).

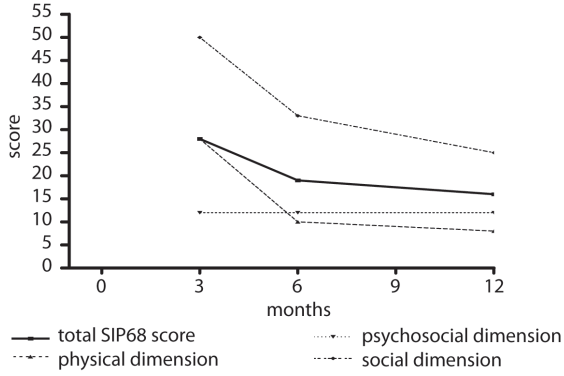

Fig. 2. The course of functioning in the 3 dimensions of the Sickness Impact Profile 68 (SIP68) in the 21 patients with complete data.

Secondary outcomes

Impairments in body functions, limitations in activities, and restrictions in participation. A checklist of impairments in functions, limitations in activities, and restrictions in participation, which was used in patients during the follow-up appointments after 3 and 12 months, is shown in Appendix I.

Body functions. Figs 3 and 4 show the proportion of patients reporting impairments in mental function (ICF-B1), sensory functions and pain (ICF-B2), and neuromusculoskeletal and movement-related functions (ICF-B7), at 3 months ($n=18$) and at 12 months ($n=22$) after discharge from the ICU.

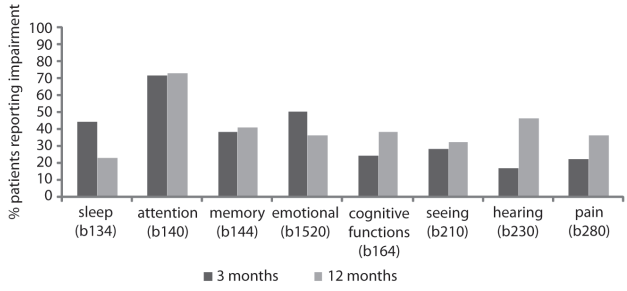

Fig. 3. Proportion of patients reporting impairments in mental functions, sensory functions and pain.

Table II. *Functional status as measured with the Sickness Impact Profile 68 (SIP68)*

SIP68	3 months after ICU $n=29$		6 months after ICU $n=29$		12 months after ICU $n=30$	
Scorings range 0–100	Median	IQR	Median	IQR	Median	IQR
Physical dimension	26	10–41	15	5–24	10	1–19
Somatic autonomy	11	0–6	8	0–6	0	0–6
Mobility control	42	25–67	33	4–50	17	4–46
Mobility range	30	0–65	20	0–45	0	0–30
Psychosocial dimension	18	0–41	12	0–35	12	0–50
Psychic autonomy and communication	9	0–32	18	0–27	18	0–50
Emotional stability	17	0–50	0	0–33	17	0–33
Social dimension	50	21–83	33	21–83	25	13–58
Social behavior	50	21–83	33	21–83	25	13–58
Total SIP68 score	28	14–45	19	12–35	22	7–29

SIP68: scores range from 0–100 with lower scores indicating better functioning.
ICU: intensive care unit; IQR: interquartile range.

After 3 months the following problems related to the mental and digestive functions with respect to the intake of food were reported: 72% (standard error (SE) 11, $n=13$) loss of taste (ICF b1563), 39% (SE 12, $n=7$) loss of appetite (ICF b535), 11% (SE 7, $n=2$) swallowing problems (ICF b510), and 50% (SE 24, $n=9$) difficulty maintaining weight (ICF b 530). After 12 months these problems had decreased to 23% (SE 9, $n=5$) loss of taste, 9% (SE 6, $n=2$) loss of appetite, 5% (SE 5, $n=1$) swallowing problems, and 9% (SE 6, $n=2$) difficulty maintaining weight.

After 3 months 44% (SE 12, $n=8$) patients had upsetting thoughts or memories about their ICU stay, and 28% (SE 11, $n=5$) had bodily reactions (such as fast heartbeat, stomach churning, sweatiness, and dizziness) when reminded of their ICU stay. After 12 months this was respectively 23% (SE 9, $n=5$) and 18% (SE 8, $n=4$).

Activities and participation. Figs 5 and 6 show the proportion of patients reporting impairments in mobility (ICF-D4); domestic life (ICF-D6); major life areas (ICF-D8); and community, social, and civic life (ICF-D9).

Employment status. One year after discharge from the ICU, only 5 of the 12 patients who were employed before ICU admission had returned to work. Concomitantly, the number of patients on sick leave was increased from 0 before ICU to 6 one year after ICU. One of the patients who was employed before ICU entered retirement.

Rehabilitation therapy. Three months after discharge from the hospital, 13 of 29 (45%) patients followed an interdisciplinary rehabilitation programme. Six patients still participated in interdisciplinary rehabilitation treatment after one year.

In Fig. 7, the proportion of patients who received treatment from a physical therapist, psychiatrist/psychologist, occupational therapist, or a social worker is shown.

We found that after 3 months, of 16 patients with high levels of physical restrictions (SIP68 physical dimension >20), 14 received physical therapy, while only 6 of 13 patients with high levels of psychological distress (SIP68 psychological dimension >20) received psychological treatment, and 13 of 22 patients with severe social health problems (SIP68 social health dimension >20) received counselling from a social worker. Of the 18 patients with severe limitations in daily functioning (SIP68 >20), 7 patients had occupational therapy. After 12 months, 4 of 7 patients with high levels of physical restrictions received physical therapy, 6 of 13 patients with high levels of psychological distress received psychological treatment, and 4 of 19 patients with severe social health problems received counselling from a social worker. Of the 15 patients with severe limitations in daily functioning after 12 months, 3 had occupational therapy.

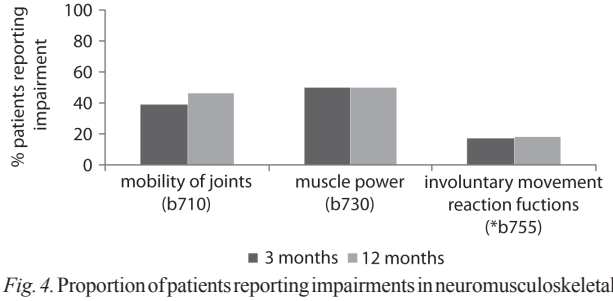

Fig. 4. Proportion of patients reporting impairments in neuromusculoskeletal and movement-related functions. *b755: patients were asked with respect to balance problems related to neuromusculoskeletal impairments.

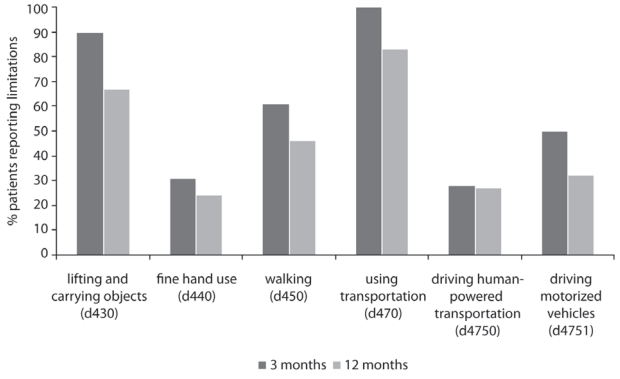

Fig. 5. Proportion of patients reporting limitations in mobility.

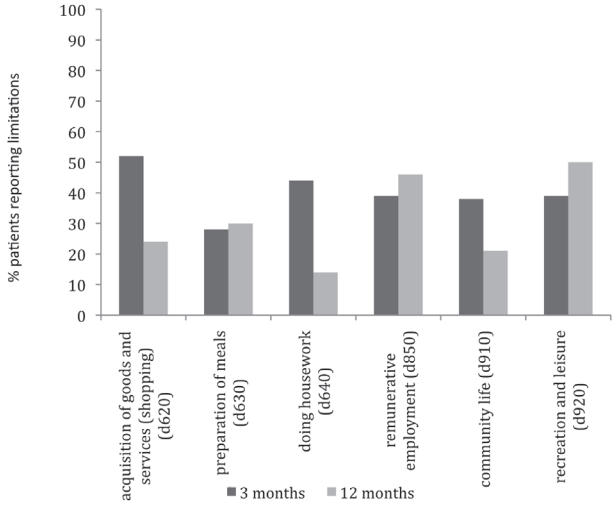

Fig. 6. Proportion of patients reporting limitations in domestic life, major life areas, community, and social and civic life.

DISCUSSION

Although functional health status (SIP68) improved during the first year in this prospective follow-up of survivors of a critical illness, two-thirds of the survivors still encountered limitations in daily functioning one year later. They reported a variety of impairments in body functions, limitations in activities, and restrictions in participation. There was a different time course for physical and psychological recovery with significant improvement in physical functioning, while impaired psychological functioning remained unchanged.

Of the patients who were ventilated for more than 48 h, 69% were still restricted in performing daily activities (SIP68 > 10), of whom 75% had severe impairments (SIP68 > 20), one year after ICU discharge. Our findings are consistent with data published previously, reporting persistent functional limitations (11) and decreased quality of life in ICU survivors at one year after discharge from the ICU (8, 22). One year after discharge from the ICU, the functional status of patients in the present study was worse compared with a previous cross-sectional study performed in our centre (median SIP68 score was 11 in the former, vs 22 in the latter) (10). Although we applied the same inclusion criteria in both studies, the baseline characteristics with respect to prognostic factors for poor functional status (identified in our previous study) (10), were different. Moreover, the high severity of illness during ICU stay in this prospective cohort (i.e. higher APACHE scores at ICU admission, longer ICU LOS, more acute ICU admissions) can be explained by the relatively short inclusion period during summer, during which less scheduled surgery is performed in our hospital and more acute patients are admitted to the ICU. Consequently, and in spite of the high follow-up rate, in this prospective consecutive series of ICU patients, the severity of illness may be somewhat higher than the mean of our ICU population.

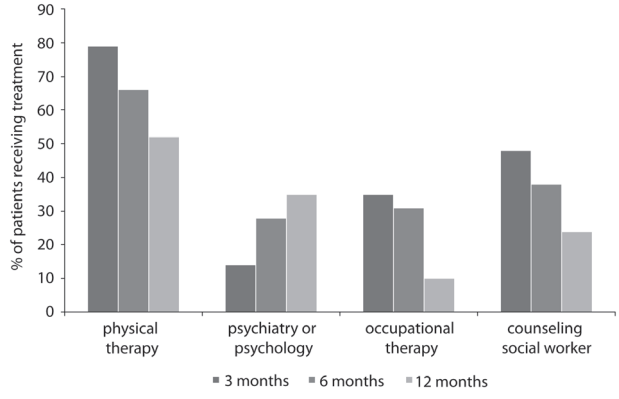

Fig. 7. Proportion of patients receiving rehabilitation treatment.

In agreement with previous authors (10, 11, 23, 24), we believe it is very likely that impairments in neuromuscular and movement-related body functions, such as muscle weakness (reported by 50%), joint stiffness (reported by > 40%), and balance problems (reported by 17%), contribute to the high prevalence of limitations in the domain of mobility (Fig. 5). In addition, the impairments in sensory functions and pain, such as impaired hearing (> 40%), impaired vision (> 30%), and pain (> 20%), may also complicate the performance of usual daily activities.

Data from recent studies indicate that critical illness can lead to significant neurocognitive impairments, which may have consequences for quality of life, the ability to return to work, and overall functional ability (25). We believe that the high incidence of impairments of mental functions in our study population, in particular reduced attention (73%), emotional instability (41%), sleeping problems (23%), and upsetting thoughts or memories about the ICU (23%) interfere with daily functioning. Furthermore, we assume that the incidence of post-traumatic stress disorder (PTSD) might have been high in our population. PTSD-related symptoms include intrusive recollections (re-experiencing the trauma in flashbacks, memories or nightmares); avoidant and numbing symptoms (including diminished emotions and avoidance of situations that are reminders of the traumatic event); and hyperarousal (including increased irritability, difficulty sleeping or concentrating) (26). Although we did not measure the presence of PTSD-related symptoms using a questionnaire that was developed for this purpose, and we did not evaluate the presence of avoidant symptoms, we noticed that the prevalence of hyperarousal, and intrusive symptoms was high in our study population.

Another striking result is that 50% of patients reported weight loss after 3 months. With respect to the high incidence of loss of taste (> 70%) and loss of appetite (40%), we suspect that a large proportion of ICU survivors suffer from underfeeding. Loss of body weight and inadequate intake of quantities nutrients has been described in critically ill patients who characteristically exhibit raised energy expenditure (11, 22). Protein energy malnutrition is one of the most common forms of malnutrition and is characterized by low body weight, small muscle mass, and lack of energy, all of which are likely to impede recovery.

Obviously, the wide range of impairments and limitations that were identified in this study may account for restrictions

in participation, such as taking part in recreational activities (50%) and problems with returning to work (> 40%), and lead to a great personal burden, as illustrated by a high social health SIP score (Table II).

The overall patterns of recovery in the different health domains evaluated in this study show improvement in physical functioning and social health, while impaired psychological functioning remained unchanged (Fig. 2). This finding is in accordance with studies evaluating the course of recovery in other populations with traumatic injuries (27, 28). A possible explanation for this continuing psychological morbidity while physical health improves may be found in Lazarus and Folkman's theory of psychological stress and coping. According to this theory, stress arises when demands in a situation are appraised by people as taxing or exceeding their resources and endangering personal well-being (29). After a period of "literally surviving" and rapid physical improvement, patients with traumatic injuries may face physical, psychological, social, and economic problems. In patients in the ICU, impairments in body functions and limitations in daily activities, and the resulting dependence on help from others and involuntary inactivity; the traumatic experience of critical illness; and uncertainty about functioning in the future are all potential stress factors that are very likely to induce psychological distress when long-term physical restrictions become manifest.

Between 3 and 6 months after ICU, substantial improvements in physical functioning and social health occur, followed by relatively slow progress during the subsequent 6 months (Fig. 2). It is alarming that 12 months after discharge from the ICU, 25% of patients still have high levels of restrictions within the physical, psychological, and social health domains (Table II: SIP68 inter-quartile ranges physical > 19, psychological > 50, and social health > 58).

To date, in most countries, patients are not routinely referred to rehabilitation services. In fact, specialized aftercare for ICU survivors is currently not widely available (30). An interesting observation in this study is that a large proportion of patients with severe psychological or social problems did not receive psychological treatment or counselling from a social worker. Given this tendency, we hypothesize that psychological and social problems after discharge from the ICU often remain unrecognized. In contrast, the majority of patients with impairments in physical function received (usually prolonged) physical therapy treatment. Moreover, we found that, in spite of prolonged physical therapy treatment, one year after discharge from ICU a majority of patients still suffered from physical impairments such as muscle weakness and joint stiffness (Fig. 3). It is unclear whether the physical impairments of patients discharged from the ICU could be considered as more or less persistent, or whether the physical therapy provided was suboptimal for these specific ICU-related sequelae.

In the literature, only a few studies have been reported regarding the efficacy of specific interventions during ICU stay and after discharge at improving functional outcome in ICU patients. The positive effects of a physical training programme on functional status in patients requiring prolonged mechanical ventilation have been described by Chiang et al. (31) and Nava (32). In mechanically ventilated patients requiring complete neuromuscular blockade, Griffiths et al. (33) found a positive effect of passive stretching on the preservation of muscle fibres. Furthermore, a self-help rehabilitation manual has been demonstrated in aiding physical recovery after ICU discharge (24, 31). The effects of individually tailored exercise programmes have not yet been investigated in ICU survivors. However, the positive effects in other populations, such as elderly people after cardiac surgery, diabetes and stroke are promising and could be useful for patients after discharge from the ICU (34–36). With respect to PTSD-related symptoms, Jones et al. (37) concluded that the provision of an ICU diary may reduce the level of PTSD symptoms. Furthermore, psychological treatment consisting of cognitive behavioural therapy has been proven to be effective at reducing traumatic stress symptoms in individuals with PTSD (38).

There are some limitations to this study. We found that the poor health status of the participants, together with a high mortality rate, impeded follow-up of the complete sample of patients. Consequently, data could not be obtained from all participants at all measurement points. Although GEE analysis allows for the inclusion of data on patients with incomplete follow-up, the selection of patients with a relatively good health status seems likely, and our findings probably underestimate the problems in daily functioning encountered by ICU survivors.

Selection bias could have occurred with respect to the patients who were lost to follow-up before the first assessment, because they were discharged to another hospital. Although according to hospital policy, ICU patients are discharged and transferred to a referral hospital for further treatment regardless of their physical resilience, it is unknown whether the health status of these patients was comparable to that of the study population.

Finally, some patients received physical therapy and/or psychological counselling during the study period. No specific standardized aftercare was provided to these patients and the effect on outcome of these treatments is unknown.

The present study provides useful information on functional recovery during the first year following critical illness and may guide the planning of follow-up care for ICU survivors. The extent of impairments in functioning and the course of functional recovery underscore the need for multidisciplinary treatment targeting these specific problems early after discharge from the ICU. The ICF (21) offers a useful framework for the assessment and reporting of the typical spectrum of problems in functioning in patients after discharge from the ICU. With respect to the recovery course, the heterogeneity of the population, and the variety of outcomes, we propose a multidisciplinary stepped care approach with different degrees of therapeutic intervention depending on each patient's individual needs. This may involve the use of self-help programmes to assist individuals to cope with mental dysfunctions, including PTSD-related symptoms and to improve physical recovery. Patients who do not respond to this or who exhibit greater symptom levels may then be referred to specialist multi-professional services. Rehabilitation medicine could play an important role, as it already has expertise in aiding recovery and regaining or maximizing functional status in a wide

variety of conditions. A carefully planned multidisciplinary rehabilitation programme may help patients to improve functional independence and return to work or to activities of daily living. The early identification of rehabilitation needs can also help to prevent chronic disability, and can reduce healthcare costs as well as economic costs due to limited job participation.

Future research should be aimed at developing an evidence-based multidisciplinary aftercare programme for patients after a critical illness.

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APPENDIX I. International Classification of Functioning, Disability and Health checklist and proportion of patients with reported impairments in functions, limitations in activities and restrictions in participation after 3 and 12 months

	3 months proportion (SE)	12 months proportion (SE)
BODY FUNCTIONS		
B1 Mental functions		
b134 Sleep	0.44 (0.12)	0.23(0.09)
b140 Attention	0.72 (0.11)	0.73 (0.1)
b144 Memory	0.38 (0.11)	0.41 (0.11)
b152 Emotional		
– Regulation and range of emotion	0.50 (0.12)	0.36 (0.10)
– Sadness	0.33 (0.11)	0.27 (0.10)
– Tension	0.33 (0.11)	0.27 (0.10)
– Anxiety	0.33 (0.11)	0.18 (0.08)
– Lability of emotion	0.33 (0.11)	0.41 (0.11)
b156 Perceptional function (b1563 loss of taste)	0.72 (0.11)	0.23 (0.09)
b164 Higher level cognitive functions	0.24 (0.10)	0.38 (0.10)
B2 Sensory functions and pain		
b210 Seeing	0.28 (0.11)	0.32 (0.1)
b230 Hearing	0.17 (0.09)	0.46 (0.11)
b280 Pain	0.22 (0.10)	0.36 (0.10)
B3 Voice and speech functions		
b310 Voice	0.17 (0.09)	0.14 (0.07)
B4 Functions of the cardiovascular, haematological, immunological and respiratory systems		
b440 Respiration	0.44 (0.12)	0.50 (0.11)
b4552 Fatiguability	0.93 (0.06)	0.83 (0.10)
B5 Functions of the digestive, metabolic and endocrine systems		
b510 Ingestion functions (swallowing)	0.11 (0.07)	0.05 (0.05)
b530 Weight maintenance functions	0.50 (0.24)	0.09 (0.06)
b535 Sensations associated with the digestive system (loss of appetite)	0.39 (0.12)	0.09 (0.06)
B7 Neuromusculoskeletal and movement-related functions		
b710 Mobility of joint	0.39 (0.12)	0.46 (0.11)
b730 Muscle power	0.50 (0.24	0.50 (0.11)
b755 Involuntary movement reaction functions (balance)	0.17 (0.09)	0.18 (0.08)
B8 Functions of the skin and related structures		
b840 Sensation related to the skin; itching (pruritis)	0.17 (0.09)	0.05 (0.05)
ACTIVITIES AND PARTICIPATION		
D4 Mobility (general)	0.72 (0.11)	0.46 (0.11)
d430 Lifting and carrying objects (groceries)	0.90 (0.07)	0.67 (0.10)
d440 Fine hand use	0.31 (0.11)	0.24 (0.09)
d450 Walking	0.61 (0.12)	0.46 (0.11)
d470 Using transportation	1 (0)	0.83 (0.08)
d475 Driving		
d4750 Driving human-powered transportation (bicycle)	0.28 (0.11)	0.27 (0.10)
d4751 Driving motorized vehicles	0.50 (0.24	0.32 (0.1)
D5 Self care	0.50 (0.24	0.06 (0.05)
d510 Washing oneself	0.11 (0.07)	0.07 (0.05)
d520 Caring for body parts	0.06 (0.06)	0 (0)
d530 Toileting	0.06 (0.06)	0 (0)
d540 Dressing	0.06 (0.06)	0 (0)
d550 Eating	0 (0)	0 (0)
d560 Drinking	0 (0)	0 (0)
D6 Domestic life		
d620 Acquisition of goods and services (shopping)	0.52 (0.12)	0.24 (0.09)
d630 Preparation of meals	0.28 (0.11)	0.30 (0.10)
d640 Doing housework	0.44 (0.12)	0.14 (0.07)
D8 Major life areas		
d850 Remunerative employment	0.39 (0.12)	0.46 (0.11)
D9 Community, social and civic life		
d910 Community life	0.38 (0.11)	0.21 (0.09)
d920 Recreation and leisure	0.39 (0.12)	0.50 (0.11)

SE: standard error.