Functional recovery after critical illness

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CHAPTER 7

LONG-TERM PHYSICAL FUNCTIONING CAN BE PREDICTED 3 MONTHS AFTER DISCHARGE FROM THE INTENSIVE CARE UNIT

M. van der Schaaf, A. Beelen, D.S. Dettling, M.B. Vroom, and F. Nollet

Submitted
ABSTRACT

Objective
To determine the prognostic value of physical and mental health before intensive care unit (ICU) admission and 3 months after ICU discharge on functional outcomes after one year.

Design
Prospective, observational, inception-cohort study with 4 measurements over 1-year’s follow-up.

Setting
A combined medical and surgical ICU at a university hospital.

Participants
38 consecutive adult ICU patients who were ventilated >48 hours.

Interventions
None.

Main outcome measures
Medical Outcomes Study Short Form 36, walking capacity (6 minute walking test), and grip-strength.

Results
SF-36 physical functioning (PF) improved during the first year, but remained below pre-ICU values. SF-36 mental health (MH) was less affected by ICU stay and returned to pre-ICU values in most patients. Walking capacity and grip-strength improved substantially within the first 3 months after ICU discharge. PF before ICU admission and physical capacity 3-7 days after ICU discharge were not associated with PF at 12 months. MH before ICU admission and after 3 months were both moderately associated with MH after 12 months (r=0.43, p=0.03 and r=0.54, p=0.009, respectively). PF and walking capacity at 3 months, and PF at 12 months were strongly associated (PF r=0.74, p<0.001, walking capacity r=0.72, p=0.002). The PF cut-off value of 60 at 3 months for poor physical outcome had 100% sensitivity and a positive predictive value of 59%.

Conclusion
A majority of ICU patients have incomplete physical recovery after one year, while mental health quickly returns to pre-ICU values. Patients at risk for poor functional recovery can be identified 3 months after ICU discharge.

Key words
Intensive care; disability evaluation, prognosis, recovery of function; quality of life; rehabilitation; longitudinal study
Follow-up studies show that patients who have been admitted to an intensive care unit (ICU) have reduced quality of life (QoL) and encounter long-lasting restrictions in physical and psychological functioning.\textsuperscript{1,2} Although prognostic factors for long-term QoL in ICU patients were identified in a few studies\textsuperscript{2}, the evidence regarding their predictive value for physical and mental recovery is still limited.

With advances in the treatment of critically ill patients, the number of patients surviving the ICU who are burdened with the long-term sequelae of critical illness is likely to increase.\textsuperscript{1,3} Functioning improves over time after discharge from the ICU, but functional restrictions are still highly prevalent one year after ICU discharge.\textsuperscript{1,3} In a previous study on functional status, more than half of the survivors of a critical illness had restrictions in daily functioning one year after discharge from the ICU which resulted in reduced physical, social, and psychological well-being.\textsuperscript{4}

To improve the outcome of ICU survivors, specialized multidisciplinary follow-up care, tailored to the specific ICU related sequelae, is becoming available.\textsuperscript{5} In hand with this, predictions of long-term functional outcome and the identification of those patients at the greatest risk for a poor outcome are becoming important.

Older age and increased severity of illness were identified as predictors of poor long-term physical functioning in ICU survivors,\textsuperscript{2} while patient gender, length of ICU stay, and admission diagnosis category do not appear to be important predictors of QOL.\textsuperscript{2,4} Nevertheless, the clinical value of these predictors, with respect to identifying patients at risk for poor functional recovery sooner, remains unsatisfactory. To date, in the absence of clinical predictors for functional outcome, it is still not possible to identify patients who are at risk for lasting functional limitations and who are most likely to benefit from rehabilitative care.

The purpose of this study was to examine the course of physical and mental recovery in ICU patients, and to determine the prognostic value of patients’ physical and mental health before admission to the ICU and 3 months after ICU discharge, with respect to physical and mental health one year after discharge.

**Materials and methods**

**Study population**

All adult patients (aged ≥ 18 years), who were admitted to the 28-bed, mixed medical and surgical closed-format ICU of the Academic Medical Center, University of Amsterdam, between June 1 and August 31, 2005, who
received mechanical ventilation for more than 48 hours, and who were able to complete the Dutch version of the SF-36 questionnaire regarding their QoL before ICU admission within 1 week after ICU discharge, were eligible to participate in the study.

No standardized after-care focusing on ICU-related sequelae was offered. The usual care that is provided after hospital discharge may include rehabilitation therapy consisting of 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 approval because of the non-interventional nature of the study.

Outcome measures

The Physical Functioning (PF) and Mental Health (MH) dimensions of the Medical Outcomes Study 36-item Short-Form General Health Survey (SF-36) were used as primary outcome measures to assess physical and mental functioning. Patients were asked to complete the SF-36, including the other dimensions (i.e. role limitation due to physical problems [RP], role limitation due to emotional problems [RE], bodily pain [BP], general health [GH], vitality [VT], and social functioning [SF]) at 3, 6, and 12 months after ICU discharge.

As secondary outcomes, walking speed (6-minute walk test; 6-MWT) and grip-strength (digital hand-grip dynamometer) were assessed 3-7 days after discharge from the ICU on the regular ward, and after 3 and 12 months in our outpatient clinic.

Health-related quality of life (QoL), including PF and MH, prior to admission to the ICU was evaluated using the SF-36. For this, patients were asked, within 1 week after ICU discharge, to indicate the statement that best described their health status in the 4 weeks prior to ICU admission. The SF-36 has been used extensively to assess QoL in people before and after ICU admission, and has been translated and validated in Dutch.6 Answers were transformed, weighed, then subsequently scored and aggregated to summary measures according to predefined guidelines. Scores for each aspect can range from 0 (worst) to 100 (best). Poor PF and MH were defined as an individual score that was less than 1 SD below the Dutch general population.6 A change in an individual score of more than 10 points was considered clinically relevant.

Walking speed, as a measure of physical capacity, was evaluated with the 6-MWT according to a standardized protocol. Because of the poor health condition of patients shortly after discharge from the ICU, the 2-MWT was used for the first assessment. These tests provide a standardized, objective, integrated measure of the cardiopulmonary and musculoskeletal system that is relevant for the performance of daily activities.7
Hand-grip-strength was measured as an indicator of general muscle strength. Grip-strength correlates with general muscle strength, but has also proved to be a strong predictor of physical functioning and disability.\(^8\) A digital hand-grip dynamometer (Lode BV, Groningen, the Netherlands) was used to measure grip-strength with the test positions recommended by Firrell.\(^9\) All assessments were standardized and carried out by experienced senior physiotherapists. Information about the patients’ characteristics was obtained from medical records and the computerized hospital database, and included age, sex, duration of mechanical ventilation, ICU admission diagnosis category, and the Acute Physiology and Chronic Health Evaluation II (APACHE II) score. 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 hours 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 more severe disease and a higher risk of death.\(^10\)

**Data-analysis**

Baseline data and outcome measures were analyzed with descriptive statistics. The data are expressed as the mean ± SD, but if the distribution was skewed, medians and interquartile ranges are presented. The Pearson correlation coefficient was used to study the association between the independent potential prognostic variables for PF and MH 12 months after discharge from the ICU. The patient’s PF prior to ICU, walking capacity, and grip-strength 3-7 days after ICU, and PF 3 months after discharge were used as potential prognostic variables for PF at 12 months. As prognostic variables for MH 12 months after discharge, MH prior to ICU admission and at 3 months after discharge was used. A \(P\)-value of <0.05 was considered to be statistically significant.

The sensitivity, specificity, and positive (PPV) and negative (NPV) predictive values for poor outcome were calculated. Therefore, the PF and MH scores were dichotomized. We used data from the general Dutch reference population\(^6\) to determine the cut-off, by calculating the standard deviation (1 SD) for PF and MH from the reference data (i.e. 60 points). The scores in our data set that were worse than this cut-off were classified as poor PF and MH, respectively.

The descriptive, parametric, and non-parametric statistical analyses were performed using SPSS 16.0 (SPSS Inc, 444 North Michigan Ave, Chicago, IL 60611, USA).
116 patients ventilated >48 hours

- 28 died in ICU
- 2 excluded

86 patients discharged from ICU

- 48 no SF-36 pre-data
  - 24 ‘refused’ poor health
    - of whom 15 died in hospital
  - 21 lost to follow-up
  - 3 refused (personal reasons)

3-7 days after ICU discharge (n=38)
- 38 completed SF-36 pre-ICU
  - 17 performed walking test
  - 34 grip-strength evaluated

- 1 refused participation

3 months after discharge (n=37)
- 27 completed SF-36
  - 17 attended follow-up appointment
  - 10 missed evaluation (10 poor health)

- 2 died

6 months after discharge (n=35)
- 27 completed SF-36
  - 8 missed evaluation (7 poor health)

- 4 died

12 months after discharge (n=31)
- 28 completed SF-36
  - 22 attended follow-up appointment
  - 3 missed evaluation (3 poor health)*

* 3 were alive after 12 months but missed all follow-up evaluations

Figure 7.1 Participant recruitment and follow-up
Results

Of the 116 patients who were ventilated >48 hours, 28 died in the ICU and 2 were excluded (one each for language and mental retardation); consequently, 86 eligible patients were discharged to the regular hospital ward from the ICU.

Twenty-four patients were not approached for study participation because of their poor health condition; of these, 15 died during their hospital stay and 9 were awaiting admission to a nursing home or terminal care facility.

Twenty-one patients were lost to follow-up; 20 because of early discharge to the referral hospital, and 1 patient was lost to follow-up when he left the hospital without medical permission. Three patients refused to participate for personal reasons.

Thirty-eight patients completed the SF-36 questionnaire before ICU admission. As a result of death or poor health over the study period, data could not always be obtained from all patients. The populations evaluated 3-7 days after ICU discharge, and 3, 6, and 12 months after discharge, consist of different subsets of patients. Consequently, complete SF-36 data were obtained from 20 patients, complete grip-strength data were available from 13, and walking capacity data were available from 7 patients.

The one year mortality rate of the participants was 16% (n=6). During the follow-up period after hospital discharge, the response rate increased from 73% (27 of 37 patients) after 3 months, to 77% (27 of 35 patients) after 6 months, and 90% (28 of 31 patients) after 12 months. Non-response was primarily due to poor health. Of the 27 patients who completed the SF-36 after 3 months, 17 underwent a physical examination. After 12 months, 28 patients completed the SF-36, of whom 22 underwent the physical examination. Three patients missed all follow-up evaluations because of poor health. Figure 7.1 shows the number of survivors and exclusions, and the response rate during follow-up.

The characteristics of the study population and of the sub-group of 20 patients with complete primary outcome data are shown in Table 7.1.

Prior to ICU admission, PF was good (within 1 SD of the reference value mean) in 61% (SE 8, n=23) and poor in 40% (SE 8, n=15) of patients. Mental health was good in 75% (SE 7, n=27) and poor in 25% (SE 7, n=9) of patients. Although not significant, the mean age of the patients with good PF before ICU admission was somewhat younger than those with poor PF before ICU admission (54 years vs 61 years; p = 0.15). The majority of patients with poor PF and/or poor MH before ICU admission were admitted for medical reasons (poor PF, 73%; SE 7, n=11; poor MH, 67%; SE 8, n=6).
Table 7.1 Patient characteristics

<table>
<thead>
<tr>
<th></th>
<th>Complete Group n=38</th>
<th>Patients with primary outcome at all measurement points (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age ± SD</td>
<td>57 ± SD</td>
<td>57 ± SD</td>
</tr>
<tr>
<td>Gender</td>
<td>61% (23) male</td>
<td>70% (14)</td>
</tr>
<tr>
<td>Median LOS (IQR)</td>
<td>10 (6-15)</td>
<td>9 (7-12)</td>
</tr>
<tr>
<td>Mean APACHE II ± SD</td>
<td>16 ± SD</td>
<td>16 ± SD</td>
</tr>
</tbody>
</table>

**Admission type**

- scheduled surgery: 29% (11) vs 40% (8)
- unscheduled surgery: 26% (10) vs 20% (4)
- medical*: 45% (17) vs 40% (8)

| Median pre-SF-36 PF (IQR)      | 90 (39-96)          | 95 (46-100)                                                 |
| Median pre-SF-36 MH (IQR)      | 78 (54-95)          | 80 (52-96)                                                  |

Abbreviations: LOS=Length Of Stay; APACHE II=Acute Physiology and Chronic Health. Evaluation II; IQR= Interquartile range; Pre-SF-36 PF=Pre-ICU SF-36 dimension physical functioning; Pre-SF-36 MH=Pre-ICU SF-36 dimension mental health.

*Medical: no surgery in past 7 days prior to ICU admission.

**The course of physical functioning and mental health in patients with complete data sets Physical functioning (SF-36 PF)**

In the 20 patients with complete SF-36 PF follow-up data, the PF score increased between the 3- and 12-month periods after discharge from the ICU (indicating improved functioning), but remained lower than the pre-ICU admission values. The course of physical functioning after 3 months was different for patients who had good (within 1 SD of the normal range) and poor pre-ICU health before ICU admission. After 3 months, the median PF score was 45 in both groups. Whereas the median PF score increased to 75 after 12 months in the 13 patients with good PF before ICU admission (pre-ICU median score of 95), the median PF score did not increase in the 7 patients who had poor PF before admission to the ICU (pre-ICU median score of 35) (Figure 7.2).

Recovery was incomplete after 12 months in 8 of 13 (62%) patients with good PF before ICU admission (median ≥ 10 points below the pre-ICU value). After 3 months, the patients who had incomplete recovery had median PF
scores that were lower than that of patients who had a complete recovery (median scores of 28 versus 70, respectively).
In 3 of 7 patients (43%, SE 19) with poor PF before ICU admission (median, 35), PF was improved to good (within 1 SD of the normal mean reference value) after 12 months.

**Mental health (SF-36 MH)**

The recovery of MH took a different course compared with PF. In the 19 patients with complete SF-36 MH follow-up data, the median MH score did not change following ICU admission.
In the 14 patients with good MH before ICU admission (median PF score of 90), the median MH score was 74 after 3 months, and 82 after 12 months.

**Figure 7.2** The course of the SF 36 dimension (median) PF and MH in the 20 patients with complete data, divided in sub-groups of patients with good and poor functioning prior to ICU admission

*Abbreviations: PF = SF-36 dimension physical functioning; MH = SF-36 dimension mental health.*
At 12 months, the MH scores of all patients with good pre-ICU MH were within the normal range. In the 5 patients with poor MH before ICU admission (median PF score of 40), the median MH score was 60 after 3 months and 56 after 12 months (Figure 7.2). After 12 months, the MH score of all patients with poor MH before ICU admission returned to the pre-ICU values, whereas the MH scores had improved to good (i.e. within 1 SD from the normal range) in 2 patients. In Table 7.2, the scores on the different dimensions of the SF-36 1 month before ICU admission, and at 3, 6, and 12 months after ICU discharge are presented.

The course of the SF-36 dimensions PF and MH in patients with complete data sets are shown in Figure 7.2, divided into sub-groups of patients with good and poor physical and mental health prior to their ICU-stay.

![Figure 7.3](image)

**Figure 7.3** Course of the SF-36 physical dimensions (median) of the patients with complete data at all measurements (higher score indicating better functioning)

Abbreviations: PF=SF-36 dimension physical functioning; RP=SF-36 dimension role due to physical problems; BP=SF-36 dimension bodily pain; GH=SF-36 dimension general health.
Secondary outcomes

The course of the other dimensions of SF-36

Between 3 and 12 months after discharge from the ICU, the median scores on the physical dimensions of the SF-36 (role due to physical problems [RP], bodily pain [BP], and general health [GH]) increased (indicating better functioning), but remained lower than the scores prior to ICU admission (Figure 7.3). The median scores on the mental dimensions gradually improved after 3 months. Whereas the median scores for vitality (VT) returned to the pre-ICU values, those of social functioning (SF) and role due to emotional problems (RE) remained below the pre-ICU levels 12 months after discharge (Figure 7.4). Recovery of the physical and mental dimensions of the SF-36 in patients with complete data are shown in figures 3 and 4. The median SF-36 scores for all measurement points are presented in Table 7.2.
### Table 7.2: Scores on the SF-36 prior to ICU, and 3, 6 and 12 months after ICU discharge

<table>
<thead>
<tr>
<th>SF-36 Dimensions (norms mean; SD)</th>
<th>Prior to ICU admission</th>
<th>3 months after ICU</th>
<th>6 months after ICU</th>
<th>12 months after ICU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=38</td>
<td>n=26</td>
<td>n=27</td>
<td>n=28</td>
</tr>
<tr>
<td><strong>Physical dimensions; median (IQR)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PF (83;23)</td>
<td>90 (39-96)</td>
<td>45 (20-61)</td>
<td>50 (40-70)</td>
<td>55 (26-80)</td>
</tr>
<tr>
<td>RP (76; 36)</td>
<td>100 (0-100)</td>
<td>0 (0-25)</td>
<td>0 (0-50)</td>
<td>38 (0-75)</td>
</tr>
<tr>
<td>BP (75;23)</td>
<td>80 (45-100)</td>
<td>55 (55-82)</td>
<td>67 (43-100)</td>
<td>67 (55-97)</td>
</tr>
<tr>
<td>GH (71;21)</td>
<td>60 (30-75)</td>
<td>48 (28-61)</td>
<td>45 (30-65)</td>
<td>50 (35-60)</td>
</tr>
<tr>
<td><strong>Mental dimensions; median (IQR)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VT (69;19)</td>
<td>68 (26-75)</td>
<td>45 (39-58)</td>
<td>60 (50-70)</td>
<td>60 (45-70)</td>
</tr>
<tr>
<td>SF (84;22)</td>
<td>100 (50-100)</td>
<td>50 (38-66)</td>
<td>75 (50-88)</td>
<td>75 (50-88)</td>
</tr>
<tr>
<td>RE (82;33)</td>
<td>100 (91-100)</td>
<td>50 (0-100)</td>
<td>66 (0-100)</td>
<td>83 (8-100)</td>
</tr>
<tr>
<td>MH (77;17)</td>
<td>78 (54-95)</td>
<td>72 (56-80)</td>
<td>72 (64-84)</td>
<td>76 (60-88)</td>
</tr>
</tbody>
</table>

SD = Standard Deviation; IQR = Interquartile Range; PF = SF-36 dimension physical functioning; RP = SF-36 dimension role due to physical problems, BP = SF-36 dimension bodily pain; GH = SF-36 dimension general health; VT = SF-36 dimension vitality; SF = SF-36 dimension social functioning; RE = SF-36 dimension role due to emotional problems.

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**Figure 7.5**: Mean walking speed in patients with complete data (n=7)
The course of the physical outcome measures: walking speed and grip-strength

The course of recovery for the physical outcome measures walking speed (6-MWT) and grip-strength were similar, showing a substantial improvement during the first 3 months after discharge from the ICU, followed by a slight improvement over the subsequent 9 months. Figures 7.5 and 7.6 show the course of improvement in grip-strength (n=7) and walking speed (n=13) of patients with data at all measurement points. Table 7.3 shows the mean walking speed and grip-strength scores at all measurement points.

| Table 7.3 Outcome measures at 3-7 days and 3 and 12 months after discharge from the ICU |
|-----------------------------------------|-------------------|-------------------|-------------------|
|                                         | 3-7 days after ICU discharge | 3 months after ICU discharge | 12 months after ICU discharge |
|                                         | Mean (sd)   n    | Mean (sd)   n    | Mean (sd)   n    |
| Walking speed (m/s)                     | 0.41 (0.22)  17 | 1.01 (0.42)  17 | 1.19 (0.33)  17 |
| Grip-strength (N)                       | 174 (108)   34  | 302 (111)   17  | 340 (126)   21  |

SD = Standard Deviation.
Table 7.4 Association between potential determinants and physical functioning and mental health at 12 months

<table>
<thead>
<tr>
<th>Determinants of physical functioning</th>
<th>PF at 12 months</th>
<th>p-value</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to ICU: SF-36 PF</td>
<td>0.36</td>
<td>0.057</td>
<td>28</td>
</tr>
<tr>
<td>3-7 days after ICU: walking capacity</td>
<td>0.56</td>
<td>0.061</td>
<td>12</td>
</tr>
<tr>
<td>grip-strength</td>
<td>0.12</td>
<td>0.497</td>
<td>26</td>
</tr>
<tr>
<td>3 months after ICU: SF-36 PF</td>
<td>0.74*</td>
<td>&lt;0.001</td>
<td>22</td>
</tr>
<tr>
<td>walking capacity</td>
<td>0.72*</td>
<td>0.002</td>
<td>15</td>
</tr>
<tr>
<td>grip-strength</td>
<td>0.29</td>
<td>0.3</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Determinants of mental health</th>
<th>MH at 12 months</th>
<th>p-value</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to ICU: SF-36 MH</td>
<td>0.43*</td>
<td>0.03</td>
<td>26</td>
</tr>
<tr>
<td>3 months after ICU: SF-36 MH</td>
<td>0.54*</td>
<td>0.009</td>
<td>22</td>
</tr>
</tbody>
</table>

PF=SF-36 dimension physical functioning; MH=SF-36 dimension mental health; r=pearson correlation coefficient.
* Correlation is significant at the 0.05 level (2-tailed).

Determinants of physical and mental functioning after 12 months

The PF before ICU admission and physical function 3-7 days after ICU discharge (i.e. walking capacity and grip-strength) were not associated with PF 12 months after discharge (Table 7.4). The PF and walking capacity 3 months after discharge were strongly associated with PF at 12 months. The PF score at 3 months explained 61% of the variance in the PF score at 12 months. Moderate associations were found between MH prior to ICU admission or MH 3 months after discharge, and MH 12 months after discharge. The sensitivity of the PF cut-off value of 60 at 3 months for poor physical outcome was 100% (all 10 patients with a score <60 at 12 months had a score <60 3 months after discharge). The PPV was 59% (of 17 patients with a score <60 at 3 months, 10 also had scores <60 at 12 months). The sensitivity for the MH cut-off value of 60 at 3 months after discharge was 50% and the PPV was 33% (Table 7.5).
Table 7.5 Diagnostic characteristics of the cut-off value 60 for PF and MH at 3 months

<table>
<thead>
<tr>
<th>Diagnostic characteristic</th>
<th>Cut-off value PF 60 (3 months)</th>
<th>Cut-off value MH 60 (3 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (%)</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Specificity (%)</td>
<td>42</td>
<td>75</td>
</tr>
<tr>
<td>Positive predictive value (%)</td>
<td>59</td>
<td>33</td>
</tr>
<tr>
<td>Negative predictive value (%)</td>
<td>100</td>
<td>86</td>
</tr>
</tbody>
</table>

Discussion

This prospective study on the physical and mental recovery of ICU patients confirms that most improvements in PF occur primarily within the first 6 months after discharge from the ICU, but that the PF scores remain below both the pre-ICU values and normative values 12 months after discharge. In contrast, MH is restored to pre-ICU values much sooner, at 3 months after discharge. Most importantly, our study demonstrates that it seems possible to predict long-term restrictions, in particular PF, 3 months after discharge from the ICU. This enables the identification of patients who may benefit from tailored rehabilitation services.

The difference in recovery time-course across the physical and mental dimensions is in accordance with existing literature.\textsuperscript{2,11} In a systematic review of QoL assessed with the SF-36 in general ICU patients, clinically meaningful improvement in PF scores was found between 1 and 6 months, 1 and 9 months, and 1 and 12 months follow-up, while no study demonstrated a clinically meaningful difference in MH from baseline.\textsuperscript{2} Rapid improvement in physical function (SF-36 PF) after ICU discharge, followed by a period of slower progress, was also observed for the other physical outcome measures (i.e. walking speed and grip-strength). Because the SF-36 PF dimension contains predominantly items related to walking activities, a comparable course of recovery on the 6-MWT could be expected. Apparently, the recovery of impaired grip-strength, a different aspect of physical function, follows a similar pattern as walking capacity.

We have reservations regarding the validity of the SF-36 to evaluate functioning and QoL in hospitalized patients, since some of the SF-36 PF items are not applicable to hospitalized patients (i.e. carrying out vigorous activities, carrying groceries, walking a mile, or several blocks). Yet, the results of the SF-36 after 3 months, combined with the other physical outcome measures
(walking capacity and grip-strength), which were assessed shortly after ICU discharge and after 3 months, provide a detailed picture of early physical recovery. Our findings indicate that physical recovery begins shortly after ICU discharge, with substantial improvement within the first 3 months followed by slower progress in the subsequent 9 months.

Although MH was only slightly affected by ICU admission after 3 months, the decrements which were observed in the performance of social roles due to mental functioning (i.e. SF-36 dimension, ‘role due to emotional problems’), indicates that some aspects of mental well-being are affected after an ICU stay (Figure 7.5).

Our finding that survivors of the ICU experience important decrements in the QoL domains compared with their QoL before ICU admission, and compared with the general population, is in accordance with previous studies. In a recent Dutch follow-up study of ICU survivors, similar outcomes for physical and mental health after 3 and 6 months were presented. The deterioration in functioning in our study was most pronounced for the SF-36 dimension ‘role limitations due to physical problems’ with a median score of 0 after 3 and 6 months, and a median of 38 after 12 months (median RP pre-ICU of 100; Table 7.2), which illustrates the large impact physical impairments have on daily functioning in ICU survivors.

Our study’s most important finding was that poor functional outcome can be predicted after 3 months. The identification of patients with diminished long-term physical and/or mental functioning is important, because these patients may benefit from rehabilitative treatment at an early phase of recovery. Although age and severity of illness were identified as predictors of physical functioning in a systematic review of studies on QoL in ICU survivors, the clinical predictive value with respect to the identification of patients at risk for poor functional outcome has not been discussed much. In a previous study, only 10% of functional outcome was explained by the prognostic factors, ‘severity of illness at admission,’ and ‘length of stay in the ICU.’

We note that although we expected that PF before admission to the ICU and physical capacity shortly after ICU discharge would be identified as predictors of long-term physical outcome after ICU discharge in this longitudinal study, we did not find any evidence for this.

The finding that all patients at risk for a poor outcome can be identified 3 months after ICU discharge using the threshold score of 60 points on the SF-36 PF dimension (100% sensitivity), is of clinical importance. With this cut off, all patients at risk for a poor outcome would have been referred for rehabilitation. Although this implies that 40% of the patients would be referred unnecessarily (positive predictive value 60%), we feel that the use
of this cut-off value is defensible. Priority should be given to including all patients at risk for a poor outcome over the unnecessary referral of patients, despite the costs. Additionally, we cannot preclude that all patients would not benefit from rehabilitative treatment since the results of our study show that the majority of patients who would have been referred unnecessarily did not fully recover to their pre-ICU values. However, an accurate estimate of the predictive value of this threshold should be investigated further in a multicenter study with a larger sample size.

The patients’ MH after 3 months was of limited predictive value for long-term restrictions in MH. In the absence of a time effect, and taking into account the limited number of patients with poor MH after 12 months, the prediction of recovery is also of limited interest. Four of the 5 patients with poor MH at 12 months had also poor PF at 3 months, and would therefore have been identified based on their PF score.

Potential limitations of this study are the relatively small sample size and the possibility of selection bias, and the bias of interventions aimed at physical and psychological functioning. We found that the poor health status of the participants, together with a high mortality rate, impeded a complete follow-up. Consequently, data could not be obtained from all participants at all measurement points. However, despite the small sample size, outcomes with respect to physical and mental functioning were consistent with larger previous studies. Obviously, with respect to future research, when planning follow-up care for ICU patients, one should take into consideration that only a minority (46%) of the patients were able to visit the outpatient clinic after 3 months, due to their poor health condition.

Selection bias could have occurred with respect to the 24 patients who were not approached to participate because their short life expectancy. Therefore, the health status of our study population might not be representative of all ICU patients at our hospital, but likely overestimates the outcome of survivors. Finally, no specific standardized after-care was provided during the study period. Although this was not evaluated systematically, after 3 months a majority of patients reported receiving some form of standard care, such as physical therapy (82%) and/or psychological counseling (15%). An interesting point of discussion is whether the poor outcome of many ICU survivors is the best achievable outcome, or if specific multidisciplinary rehabilitation programs should be developed for these patients to improve their outcome. Such answers can only come from future intervention studies.
Conclusion

In the majority of ICU patients who were ventilated >48 hours, physical recovery is incomplete after 12 months, while mental health is nearly restored after 3 months. It is feasible to identify patients at risk for poor functional outcome 3 months after discharge from the ICU using a threshold of 60 points on the SF-36 PF dimension (i.e. 1 SD from the mean reference population value). Future research should focus on the effect of rehabilitative interventions and whether the course of recovery can be improved, thereby improving long-term functional outcomes in ICU survivors.

References

5. Griffiths JA, Barber VS, Cuthbertson BH, and Young JD. A national survey of intensive care follow-up clinics. Anaesthesia 2006; 61: 950-955.