

Physical Effects of the Trauma and Psychological Consequences of Preexisting Diseases Account for a Significant Portion of the Health-Related Quality of Life Pattern of Former Trauma Patients

Lotti Orwelius, Max Bergkvist, Anders Nordlund, Peter Nordlund, Eva Simonsson, Carl Bäckman and Folke Sjöberg

Linköping University Post Print

N.B.: When citing this work, cite the original article.

The original publication is available at www.springerlink.com:

Lotti Orwelius, Max Bergkvist, Anders Nordlund, Peter Nordlund, Eva Simonsson, Carl Bäckman and Folke Sjöberg, Physical Effects of the Trauma and Psychological Consequences of Preexisting Diseases Account for a Significant Portion of the Health-Related Quality of Life Pattern of Former Trauma Patients, 2012, European Journal of Trauma, (72), 2, 504-512.

<http://dx.doi.org/10.1097/TA.0b013e31821a416a>

Copyright: Springer Verlag (Germany)

<http://www.springerlink.com/>

Postprint available at: Linköping University Electronic Press

<http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-17827>

Physical effects of the trauma and psychological consequences of pre-existing diseases account for a significant portion of the HRQoL pattern of former trauma patients

Short title; **HRQoL effects after trauma**

Lotti Orwelius PhD , CCRN, lotti.orwelius@lio.se^{1,2}, Max Bergkvist M.D., max.bergkvist@lio.se² Anders Nordlund Statistician, andno@telia.com³, Eva Simonsson CCRN, eva.simonsson@lj.se⁵ , Peter Nordlund M.D., peter.nordlund@lj.se⁵, Carl Bäckman PhD student, CCRN, carl.backman@lio.se⁶, Folke Sjöberg Professor, MD., folsj@ibk.liu.se^{1,4}

¹ Departments of Intensive Care, ² Medicine and Health Sciences, Faculty of Health Sciences ³ TFS Trial Form Support AB, Lund, Sweden, ⁴ The Burn Centre, and Department of Clinical and Experimental Medicine, Faculty of Health Sciences, all at the University/University Hospital of Linköping, Sweden and ⁵ Department of Anaesthesia and Intensive Care, Ryhov Hospital, Jönköping, Sweden, ⁶ Department of Anaesthesia and Intensive Care, Vrinnevi Hospital, Norrköping, Sweden

Address requests for reprints to:

Lotti Orwelius, Department of Intensive Care, University Hospital, SE-581 85 Linköping, Sweden.

E-mail: lotti.orwelius@liu.se

Fax: +46-010-103 2836

Phone: +46-010-103 3651

Supported, in part, by a grant from The Health Research Council in the South-East of Sweden (FORSS) F2004-204 and the County Council of Östergötland, Sweden. None of the authors have any financial interests to disclose.

Abstract

Background

Health related quality of life (HRQoL) is known to be significantly affected in former trauma patients. However, the underlying factors that lead to this outcome are largely unknown. In former ICU patients it has been recognized that pre-existing disease is the most important factor for the long term HRQoL. The aim of this study was to investigate HRQoL up to 2 years after trauma and examine the contribution of the trauma specific, ICU related, and sociodemographic factors together with the effects of pre-existing disease, and further to make a comparison with a large general population.

Methods

A prospective 2-year multicenter study in Sweden of 108 injured patients. By mailed questionnaires, HRQoL was assessed at 6, 12 and 24 months after the stay in ICU by SF-36, and information of pre-existing disease was collected from the national hospital database. ICU related factors were obtained from the local ICU database. Comorbidity and HRQoL (SF-36) was also examined in the reference group, a random sample of 10 000 inhabitants in the uptake area of the hospitals.

Results

For the trauma patients there was a marked and early decrease in the physical dimensions of the SF-36 (RP and BP). This decrease improved rapidly and was almost normalized after 24 months. In parallel there were extensive decreases in the psychological dimensions (VT; SF; RE; MH) of the SF-36 when comparisons were made with the general reference population.

Conclusions

The new and important finding in this study is that the trauma population seems to have a trauma specific HRQoL outcome pattern. Firstly, there is a large and significant decrease in the physical

dimensions of the SF-36 which is due to musculoskeletal effects and pain secondary to the trauma. This normalizes within 2 years whereas the overall decrease in HRQoL remains and most importantly it is seen mainly in the psychological dimensions and it is due to pre-existing diseases.

Key words: trauma, follow-up, critical care, comorbidity

Introduction

Trauma is a major threat to public health that causes a greater loss in productive years than cancer or cardiovascular disease.⁽¹⁾ Injured patients are often subjected to long and costly periods of intensive care. Patients who are injured have an appreciable reduction in their health related quality of life (HRQoL) after their ICU discharge compared with other groups of patients.⁽²⁻⁴⁾ Patients with physical trauma reported much physical (68%) and psychological (41%) disability five years later.⁽²⁾ Up to seven years after injury 74% were complaining of impaired HRQoL.⁽³⁾ The reason for the impairment in HRQoL and the incompleteness of the recovery seen in injured patients compared with those with other diagnoses after discharge from ICU and hospital is still not clear.

Several factors affect how patients rate their HRQoL during or after an episode of critical care. The most important are age,⁽⁴⁻⁸⁾ sex,^(6,9) and intensive care-related factors such as APACHE II score,^(5,10) admission diagnosis^(11,12) and length of stay in the ICU.⁽⁸⁾

In three recent studies we have found that pre-existing disease is a major contributor to a reduced HRQoL after critical care for reasons other than trauma.⁽¹³⁻¹⁵⁾ However, pre-existing disease is thought to be less prevalent in this group of patients and is therefore seldom investigated in injured patients. The overall aim of the study was to assess pre-existing diseases, their rate and

distribution and to examine their possible long term (2 years) effects on HRQoL in a group of patients with trauma injuries who required intensive care. Comparisons were also made between the injured patients and a general population group.

In this study we focus on the hypothesis that the contribution of pre-existing disease to the reduced HRQoL after discharge from ICU is important even for the patients treated for the diagnosis of trauma. A specific hypothesis is that, the early effects seen are mainly pictured in the physical dimensions of HRQoL and are due to the musculoskeletal effects of the trauma and its secondary pain problems. ⁽³⁾

Materials and Methods

Design

This prospective, longitudinal multicenter study was done in three general ICUs in Sweden: one university hospital (trauma level one facility), and two general hospitals. The ICU at the university hospital has eight beds, and 500-750 patients are admitted each year. Patients with severe head or brain injuries only, or burned patients, are treated in other specialised units in the university hospital, and were not included in this study. The two general hospitals both have six-bed ICUs, and 500-700 patients are admitted annually to each. Nearly all the admissions to these three ICUs are emergencies, and the primary admission diagnoses are most commonly: disturbances in the respiratory or the circulatory system or both, gastrointestinal problems, trauma or sepsis. Rehabilitation services for such patients are provided by each hospital on a regular basis by specific rehab teams.

Study population and reference group

All adults with trauma (18 years and older) who were admitted consecutively during two years and who remained in the ICU for more than 24 hours, and who were alive six months after discharge from hospital, were included in the study. Patients who were readmitted were included only for their first admission.

During the study period a total of 165 patients with trauma as the admission diagnosis who were aged 18 years and over were admitted to one of the three hospitals and required intensive care for more than 24 hours. One hundred and forty six patients survived the stay at ICU. Of these, 108 responded to the first inquiry at 6 months (74%), 85 responded at 12 months (58 %) and 57 responded at 24 months (39%), and they then became the long term follow – up study group.

Two patients died during the 24 months follow-up. Nineteen patients (11%) died during their stay in ICU, mainly of severe internal bleeding, brain injuries, or multiple organ failure (Figure 1).

This study is a part of a large study of all consecutive patients admitted to one of the three ICUs who were 18 years and older. In this study only the patients with admission diagnose trauma are included. In addition, data from a public health survey of the county of Östergötland (the area in which the university hospital and one of the general hospitals is situated, and adjacent to the county where the second general hospital is located) were used as a general reference group for comparison of HRQoL.⁽¹⁶⁾ Questionnaires were initially sent out to 10 000 people with age up to 74 years. After two reminders, 6093 (61%) had responded.⁽¹⁷⁾

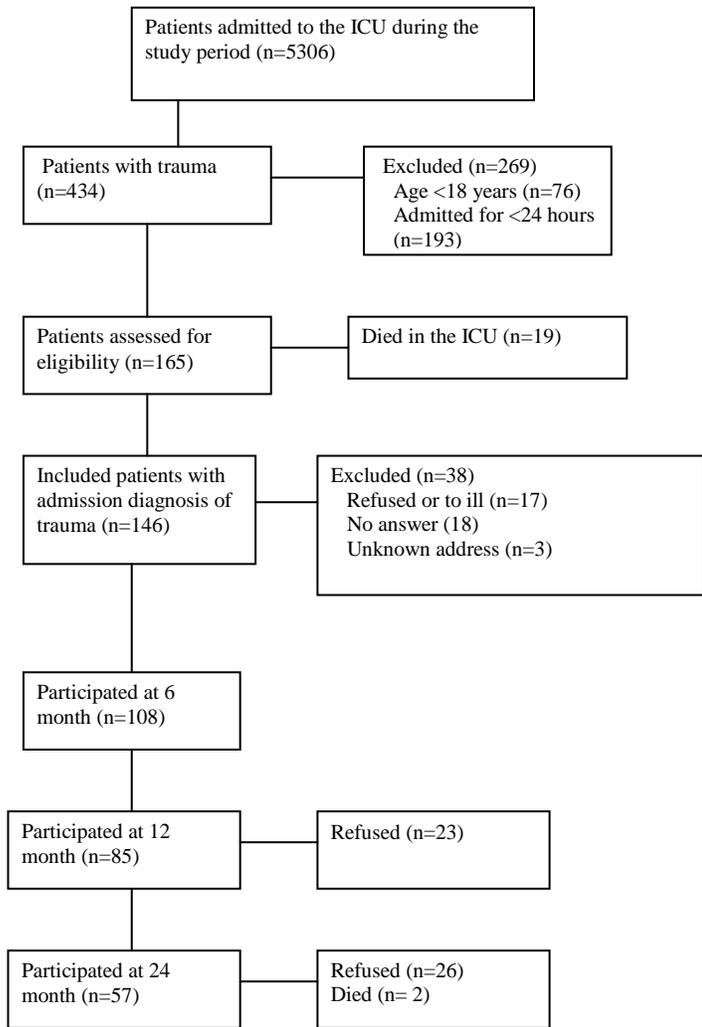


Figure 1 Patient inclusion chart.

The study was approved by the Committee for Ethical Research at the Linköping University.

Questionnaires and instruments

A set of structured questionnaires were mailed to the study population at 6, 12, and 24 months after discharge from hospital. The questionnaire contained questions about the patients' background (employment, listed sick or not, born in Sweden or not, and pre-existing diseases).

As the most common pre-existing disease provided by the patient was psychiatric disorders which are well-known to be significantly underreported we also examined all the medical records (irrespective of diagnosis, clinic or home address) including up to 15 years prior to the ICU admission. This is a unique possibility in Sweden. This was done by approaching the Swedish Board of Health and Welfare where a registry of all hospital records is kept. This includes all ICD-9 and ICD-10 diagnosis obtained by each patient after 1987.

The Swedish version of Medical Outcome Short Form (SF-36)^(18, 19) were chosen to evaluate HRQoL. The instrument is internationally well-known and have often been used.⁽²⁰⁾ It have previously been applied in intensive care,^(4, 7, 13) and have been recommended as the best instrument for measuring HRQoL in trials in critical care.⁽²¹⁾

SF-36 has been validated in a representative Swedish sample.⁽²²⁾ It has 36 questions and generates a health profile of eight subscale scores: physical functioning (PF), role limitations due to physical problems (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role limitations due to emotional problems (RE), and mental health (MH).^(18, 22) The scores of all the subscales are transformed to a scale ranging from 0 (the worst score) to 100 (the best score).

The questionnaire to the reference group in the survey 1999 also included, apart from questions on background characteristics as above, HRQoL (Medical outcome Short-Form health survey (SF-36) questionnaire), and questions about health problems. Details and the method for this part can be studied in our previous study.⁽¹³⁾

Clinical assessment scales

Severity of trauma was assessed using the injury severity score (ISS).⁽²³⁾ According to Baker⁽²³⁾ the scores are calculated and added for the three most badly injured body regions, and this provides the actual ISS value.

Organ dysfunction or failure during the intensive care period was assessed using the Sequential Organ Failure Assessment (SOFA) score.^(24, 25) To calculate the maximum SOFA score, a measure of overall organ dysfunction or failure, the highest score achieved in each of the six organ systems from the entire ICU stay is added to a summary figure.⁽²⁵⁾

Data collection

The baseline characteristics of sex; age; reasons for admission to, and length of stay in ICU; APACHE II score on admission; and outcome (dead or alive) were retrieved from each of the three hospitals registries. The ISS score was not part of the routine database in two of the three hospitals (n= 72) and was therefore calculated retrospectively by one of the authors (MB) using the 1990 version (update 1998) of the Abbreviated Injury Scale (AIS). The Maximum ISS is 75 points. If an AIS score of 6 was recorded the ISS was automatically set to 75. The maximum SOFA score was also completed retrospectively by the same author (MB) from patients' records and laboratory results, because SOFA scoring was not part of the routine databases. Information was recorded from the time of admission, and consecutively every 24 hours until discharge from

ICU. If the patient was sedated the neurological score was set to zero. Survival data were collected from the Swedish population registry.

Statistical analysis

Data are presented as descriptive statistics. Unadjusted two-sample comparisons (Pearson's chi square and Student's *t* test) were used to assess differences in background characteristics between the groups.

We used multiple regression analysis to identify how ICU factors were related to problems reported in each SF-36 dimension. In the model all variables were categorical, apart from age. To maximize the statistical power, the 6 month follow-up data was used for this purpose. In analyses, comparing HRQoL over time, only survivors with answers at the follow-ups involved in the comparison were used (n=57). A p value of less than 0.05 was considered as an indication of a significant finding.

No adjustments were made for multiple testing in this study and probabilities were regarded as descriptive.

Two-tailed values and 95 % confidence intervals (CI) are given. The Statistical Package for the Social Sciences (SPSS, version 17.0, Chicago, IL, USA) was used to aid the statistical analyses.

Results

Clinical characteristics

Details of the trauma patients who responded the inquiry and the trauma patients that did not are shown in Table 1. There were no significant differences between the two groups apart from longer stay in hospital for the responding group. The trauma group was younger (mean (SD) 44 (18) years compared with 46 (15) years), and included more men (75% compared with 2821, (46%) than the general population (data not shown).

Table 1 Demographic data intensive care patients, trauma group responders and non responders. Data are number (%) or mean (SD)

Characteristic	Trauma group (n=108)	Non responders trauma (n = 38)	p-Value (95% CI)
Sex:			0.123
Male	74 (68)	31 (82)	
Female	34 (32)	7 (18)	
Mean (SD) age (years)	44.4 (18.3)	39.8 (15.5)	0.170 (-11.2 to 2.0)
Stay in ICU (hours)	131.1 (196.9)	85.3 (95.2)	0.162 (-112.8 to 19.1)
Stay in hospital (days)	17.6 (27.7)	7.5 (8.8)	0.001 (-17.2 to -4.4)
APACHE II score	10.8 (6.5)	11.9 (8.4)	0.424 (-1.6 to 3.7)

APACHE II: Acute Physiology and Chronic Health Evaluation ICU: Intensive care unit

Details of injuries (Table 2)

ISS

The trauma group that responded at 6 months had a median ISS score of 17.0 and the responders at 24 months 18.0. There were no significant differences between the patients who responded at 6 months and the drop-outs regarding ICU-related factors (Table 2). Data for the patients who responded at 24 months are shown in Table 2.

Maximum SOFA

The patients who responded at 6 and 24 months had median maximum SOFA scores of 5 and 7, respectively (Table 2). The value recorded within the ICU period among those who responded at 24 months was higher than that of the drop-outs which was 4. Ninety-two (85%) of the trauma

patients had a maximum SOFA score of <10 (median 5), and 14 (13%) were given a score ≥ 10 (median 12). Eighty-four of the patients (78%) had dysfunction in the respiratory system followed by the neurological (n=78, 72%), cardiovascular (n=77, 71%), haematological (n=71, 66%), hepatic (n=51, 47%), and renal organ systems (n=19, 18%).

Table 2 Descriptive characteristics of ICU trauma patients at 6 months, the patients that answered at all three occasions, and the withdrawals at 12 and 24 months. Data are number (%) or mean (SD) and median

Variable	6 months (n=108)	24 months (n=57)	Drop-outs (n=51)	95% CI	p-value ‡
ISS †	18.8 (10.3) 17	21.0 (11.2) 18	16.4 (8.6) 16	-1.4 to 7.9	0.164
Maximum SOFA score †	5.3 (3.4) 5	6.1 (3.6) 7	4.5 (3.0) 4	-1.2 to 1.9	0.689
APACHE II score	10.8 (6.5) 10	11.9 (7.0) 10	9.6 (5.8) 9	-0.6 to 5.2	0.124
Stay in ICU (hours)	131.1 (196.9) 86	145.0 (243.9) 95.3	115.6 (125.9) 71	-85.6 to 93.3	0.933
Stay in hospital (days)	17.6 (27.7) 8	16.3 (23.2) 8	19.0 (32.2) 9	-13.0 to 12.2	0.954
Time on ventilator (hours)	63.7 (186.0) 0	83.7 (237.5) 14	41.4 (99.4) 0	-77.4 to 91.6	0.868
Age (years)	44.4 (18.3) 44	47.5 (19.0) 49	41.0 (17.1) 39	-3.5 to 13.0	0.258
Skull trauma	36 (33.3)	20 (35.1)	16 (31.4)		0.872
Pre-existing disease	51 (47.2)	40 (54.4)	20 (39.2)		0.760
Sickleave before admission to ICU	13 (12)	5 (9)	8 (16)		0.487
Marital status: married, n (%) †	60 (56)	32 (56)	28 (55)		0.375
Male, n (%)	74 (68)	40 (70)	34 (67)		0.296

† One and two missing values, respectively

‡ Answered at 6 months compared with withdrawals at 12 or 24 months

† Not all patients answered the question

Among the patients examined for trauma most resulted from road crashes (n= 71 (66%), followed by falls (n=13, 12%), suicide attempts (n=11, 10%), accidents in the workplace (n=9, 8%), and physical abuse (n=4, 4%). Thirty-six (33%) of the patients also had a head injury recorded.

Pre-existing disease (Table 2 and 3)

Pre-existing disease was present in 51 (47%) of the trauma patients (Table 2 and 3). In the reference group the number of people that had pre-existing diseases was 3095 (51%) (data not shown). The most common pre-existing disease was psychiatric/abuse problems (15.7 %) as

indicated by the medical records. Importantly a lower percentage of these problems were indicated by the patient in the patient inquiry (p=0.001). Furthermore, none of the abuse problems, which in the medical records accounted for 50% of the psychiatric diagnoses, were provided by the patient.

In the trauma group 13 (12%) were on sick leave before the period of critical care (Table 2). In the reference group 64 (1%) were on sick leave (data not shown).

Table 3 Preexisting diseases (self-reported and ICD-9/ ICD-10 diagnoses) among patients in the intensive care unit with admission diagnose trauma

Disease	Trauma group (n=108) self-reported	Trauma group (n=108) ICD-diagnose	p-value
Cancer	4 (3.7)	7 (6.5)	<0.001
Diabetes	2 (1.8)	3 (2.8)	0.809
Cardiovascular	6 (5.6)	15 (13.9)	<0.001
Asthma/allergy	4 (3.7)	0	
Rheumatic	3 (2.8)	2 (1.8)	<0.001
Gastrointestinal	4 (3.7)	5 (4.6)	0.653
Blood	1 (0.9)	0	
Kidney	2 (1.8)	2 (1.8)	0.845
Psychiatric/abuse	13 (12.0)	17 (15.7)	0.001
Neurological	14 (13.0)	3 (2.8)	0.287
Thyroid/metabolic disturbance	2 (1.8)	1 (0.9)	0.890
Other longterm illness	12 (23.1)	13 (12.0)	0.188
No. of diseases			
0	57 (52.8)	56 (51.8)	0.082
1	37 (34.3)	35 (32.4)	
2	11 (10.2)	14 (13.0)	
≥ 3	3 (2.7)	3 (2.8)	

Data are number (%) of totals. A patient can have more than one disease
p-value; traumagroup self-reported diagnoses as presence or absence of a
specific disease compared with registred ICD-diagnose
p-value; Chi-Square

Health-related quality of life

The mean SF-36 scores in the trauma group were significantly lower than in the age and sex adjusted general reference group ($p < 0.01$) in all eight domains on all three occasions, apart from mental health at 24 months ($p = 0.052$).

Significant improvements were seen in the trauma patients for role limitations caused by physical problems between 6 and 12 months ($p = 0.002$) with further improvements between 12 and 24 months ($p = 0.04$), and for bodily pain between 6 and 12 months ($p = 0.02$), but no further improvement at 24 months ($p = 0.62$). For the rest of the SF-36 dimensions improvements over time were not significant (Figure 2).

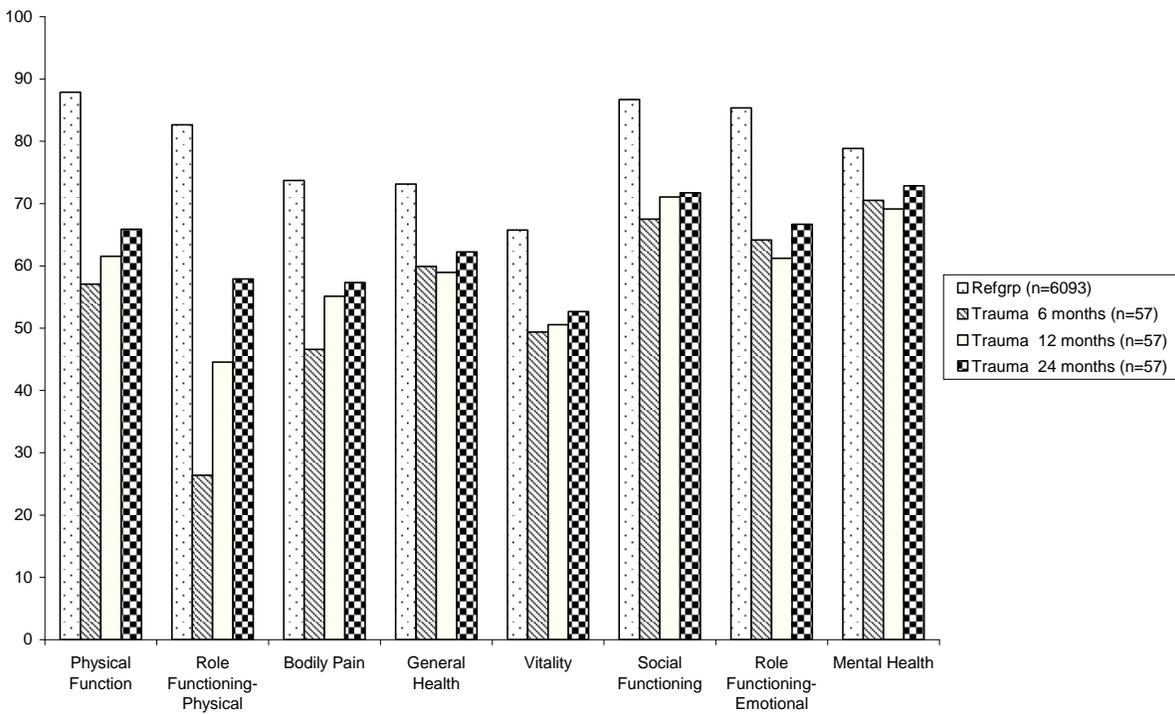


Figure 2 Medical Outcome Short Form results (SF-36) (mean) in the eight dimensions in the reference group compared with the trauma group at 6, 12 and 24 months after discharge from ICU and hospital. $P < 0.001$ in all dimensions, except Mental Health at 24 months ($p = 0.052$).

Pre-existing disease or healthy

When the trauma patients who were healthy before their stay in intensive care were compared with trauma patients who had a pre-existing disease, significant differences were found in three of eight SF-36 domains at 6 months (role physical functioning ($p=0.014$), general health ($p=0.047$) and social function ($p=0.011$)). At 12 months no significant differences were found (Figure 3).

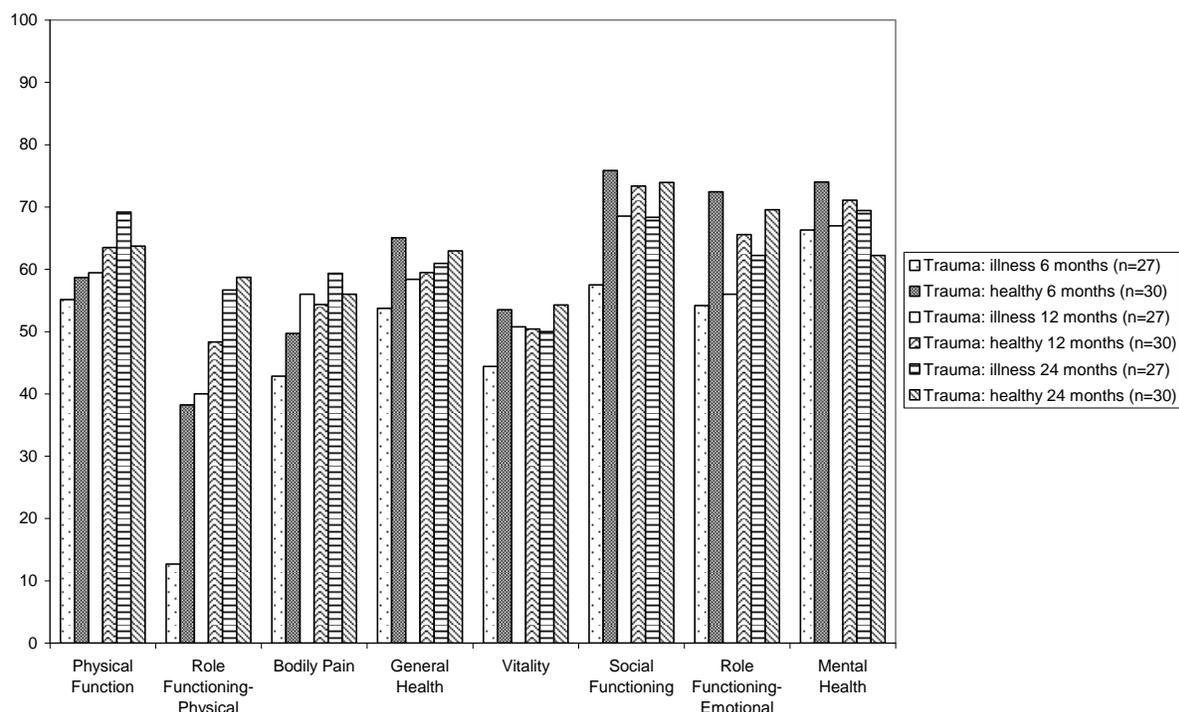


Figure 3 Medical Outcome Short Form results (SF-36) (mean) in the eight dimensions for trauma patients previously healthy and with pre-existing disease, at 6, 12 and 24 months post trauma. Significant differences (previously healthy compared with patients with pre-existing disease) were found at 6 months for Role Physical functioning ($p=0.014$), General Health ($p=0.047$), and Social Function ($p=0.011$). At 12 and 24 months no significant differences were found.

Effect of ICU and trauma factors on HRQoL

The effect of pre-existing disease on HRQoL were evaluated using multiple regression analyses allowing for the effects age, sex, ISS, maximum SOFA score, APACHE II score at admission,

length of stay in ICU and in hospital, treated on ventilator or not, pre-existing disease, sick leave before ICU care, education, marital state and employment at the time for follow-up at 6 months and the results are shown in Table 4. Pre-existing disease was most frequently associated with HRQoL, i.e. six of eight SF-36 dimensions. Maximum SOFA score was associated with physical functioning and role limitations as a result of physical problems. APACHE-II score were associated with vitality and mental health. Marital state was associated with role limitations as a result of physical problems and bodily pain.

Table 4 Impact of different factors on HRQoL, (SF-36 mean) at 6 months, Multiple regression analysis. Data are p-value, B ((95%) CI)

Variable	Physical functioning	Role physical	Bodily pain	General health	Vitality	Social functioning	Role emotional	Mental health
Injury Severity Score	0.333	0.742	0.478	0.795	0.993	0.688	0.391	0.491
≥17/ ≤16	6.2 (-6.4 to 18.8)	-3.0 (-20.9 to 14.9)	4.1 (-7.3 to 15.5)	1.2 (-8.3 to 10.8)	-0.04 (-10.4 to 10.3)	-2.4 (-14.2 to 9.4)	-8.2 (-27.3 to 10.8)	-3.6 (-14.0 to 6.8)
Maximum SOFA score	<0.001	0.009	0.465	0.280	0.774	0.751	0.149	0.959
≥5/ <4	-22.5 (-33.5 to -11.4)	-19.9 (-34.8 to -5.1)	-4.8 (-17.7 to 8.2)	-4.9 (-13.9 to 4.1)	1.6 (-9.7 to 12.9)	-2.3 (-16.4 to 11.9)	13.2 (-4.8 to 31.3)	0.3 (-11.7 to 12.3)
APACHE II score	0.298	0.984	0.470	0.117	0.045	0.151	0.651	0.030
≥15/ ≤14	6.5 (-5.8 to 18.8)	-0.2 (-17.8 to 17.5)	4.3 (-7.5 to 16.2)	6.6 (-1.7 to 15.0)	8.5 (0.20 to 16.8)	7.4 (-2.7 to 17.5)	4.6 (-15.4 to 24.5)	9.7 (0.94 to 18.5)
Length of stay in ICU	0.237	0.193	0.156	0.998	0.583	0.815	0.823	0.773
≥58/ 24-57	-6.5 (-17.5 to 4.4)	-9.7 (-24.4 to 5.0)	-7.3 (-17.5 to 2.9)	0.02 (-9.0 to 9.1)	-2.3 (-10.7 to 6.1)	-1.3 (-12.4 to 9.8)	-2.1 (-20.5 to 16.4)	-1.4 (-10.7 to 7.9)
Length of stay in hospital	0.062	0.250	0.942	0.892	0.244	0.533	0.957	0.190
≥9/ ≤8	-11.7 (-24.0 to 0.600)	-9.8 (-26.6 to 7.0)	-0.5 (-13.9 to 12.9)	0.7 (-9.7 to 11.1)	5.4 (-3.7 to 14.5)	3.5 (-7.6 to 24.3)	0.6 (-20.9 to 22.1)	6.3 (-3.2 to 15.8)
On ventilator	0.402	0.610	0.344	0.769	0.088	0.067	0.180	0.111
yes/ no	-5.5 (-18.5 to 7.5)	-4.6 (-22.7 to 13.4)	-5.1 (-15.8 to 5.6)	-1.5 (-12.0 to 8.9)	-7.9 (-17.0 to 1.2)	-10.2 (-21.1 to 0.72)	-13.3 (-32.9 to 6.2)	-7.7 (-17.1 to 1.8)
Pre-existing disease	0.453	0.051	0.016	0.007	<0.001	<0.001	0.026	<0.001
yes/ no	4.4 (7.3 to 16.1)	15.1 (0.1 to 30.3)	13.0 (2.5 to 23.6)	11.6 (3.2 to 20.0)	16.0 (7.7 to 24.3)	24.6 (14.5 to 34.8)	19.5 (2.4 to 36.5)	18.3 (9.4 to 27.1)
Sick leave before ICU care	0.018	0.478	0.904	0.650	0.412	0.271	0.426	0.129
yes/ no	21.2 (3.7 to 38.8)	9.0 (-16.1 to 34.1)	1.2 (-18.0 to 20.4)	3.2 (-10.9 to 17.4)	5.7 (-8.0 to 19.4)	8.8 (-7.0 to 24.6)	10.7 (-15.9 to 37.3)	10.5 (-3.1 to 24.1)
Education								
Higher than basic school	0.699	0.222	0.779	0.664	0.052	0.683	0.552	0.439
yes/ no	2.5 (-10.4 to 15.5)	10.4 (-6.4 to 27.2)	1.8 (-11.1 to 14.7)	2.1 (-7.4 to 11.5)	9.1 (-0.07 to 18.3)	2.6 (-9.8 to 15.0)	6.2 (-14.6 to 27.0)	3.8 (-5.9 to 13.4)
High school/university	0.753	0.582	0.473	0.871	0.723	0.446	0.392	0.757
yes/ no	-2.9 (-21.2 to 15.4)	6.5 (-17.3 to 30.6)	-5.8 (-21.6 to 10.1)	-1.1 (-14.7 to 12.5)	-2.2 (-10.3 to 14.8)	5.4 (-8.5 to 19.2)	9.9 (-13.0 to 32.9)	-2.0 (-15.2 to 11.0)
Marital state	0.471	0.011	0.049	0.315	0.528	0.368	0.456	0.197
single/married or cohabit	4.4 (-7.6 to 16.4)	19.9 (4.7 to 35.2)	10.7 (0.04 to 21.4)	-4.5 (-13.4 to 4.4)	-2.8 (-11.8 to 6.1)	4.8 (-5.8 to 15.4)	6.7 (-11.1 to 24.5)	-6.0 (-15.1 to 3.1)
Employment	0.344	0.332	0.986	0.703	0.954	0.261	0.947	0.517
employed/unemployed	-5.5 (-16.9 to 6.0)	-7.8 (-23.6 to 8.0)	-0.1 (-12.0 to 11.8)	-1.7 (-10.7 to 7.2)	0.3 (-8.9 to 9.4)	5.8 (-4.4 to 16.1)	0.6 (-18.3 to 19.5)	3.1 (-6.3 to 12.4)

Adjusted for age, and sex; Beta, unstandardized coefficient; Cut-point are median value for the trauma patients
 HRQoL; Health related quality of life, SOFA; Sequential organ failure assessment score, APACHE II; Acute Physiology and Chronic Health Evaluation

Discussion

The new and important findings in this study are that: Firstly, the early decrease in HRQoL is most pronounced in the physical dimensions, where the patients experience a significant improvement which reaches levels after two years post trauma that is comparable to other ICU patient groups.⁽¹⁵⁾ This effect seems as a cause effect of the trauma. Secondly, we show that pre-existing disease, most commonly psychiatric diagnoses and abuse, is the most important factor

for the long-term HRQoL decrease. It is interesting to note that a minority (15%) of the trauma patients are the ones affecting this outcome at the group level. Contrary to the general ICU patients that have a high burden of co-morbidity, such an effect will be more easily recognized in the trauma group with its low total co-morbidity rate. Thirdly, as expected the prevalence of pre-existing diseases are less than for other ICU patients¹⁵ but a new finding is that the distribution of the pre-existing diseases is different, encompassing more psychiatric diseases including abuse than an ordinary ICU cohort. Furthermore, as anticipated, the rate of diabetes and cardiovascular diseases was also less.⁽¹³⁾ Fourth, for the long-term HRQoL outcome ICU-related factors and sociodemographic factors had smaller effects.

The group studied

The group studied is from a rural area in and around three major Swedish cities and covers a population of roughly 1 million inhabitants. The accident profile is that often seen in a western European country, being mainly traffic crashes.^(2, 26, 27) The characteristics of these patients in respect of age, sex, and the mix of injuries, are comparable with those of other trauma studies.^(2, 3, 26-28)

The study group was all treated in critical care and the ISS and maximum SOFA scores also indicated serious trauma. This group had more serious injuries than those in a recent study⁽²⁶⁾ and was similar to yet another study of HRQoL from Sweden.⁽²⁾ It must be stressed that none of these three studies from Sweden include patients who were treated in a specialised neurosurgical ICU, which explains the lower ISS scores. It may be claimed that severe head injuries may affect the evaluation of HRQoL.⁽²⁸⁾ For this reason, the patients from this uptake area who had an important head injury during the study and were cared for in the neurosurgical ICU were excluded.

Although this study is a multicenter study, only 57 patients remained at the last follow-up (2 year follow-up). This particular group was examined for effects over time as it is claimed that only the patients answering at all occasions should be included in such an investigation and SF-36 is known to be robust over time (15, 29). In absolute terms this is a rather small sample, although often claimed sufficient for measurements of HRQoL, this number dilutes the strength of the conclusions. Therefore, we also avoided to make any further subgroup analyses.

Pre-existing disease

The prevalence of pre-existing disease where in line with other European trauma studies^(26, 28, 30) that present a range of 33% - 47%. It must also be stressed that a rather high proportion (n=13 (12%)) of the trauma patients were on sick leave before their injuries, which has also not been described before.^(31, 32) Another factor which we think is important for the outcome in our results is the presence of psychiatric and abuse problems. Such complaints are known to be significant in younger populations where somatic illnesses are less prevalent⁽³³⁾. This was also the finding of the present study where the most common pre-existing disease group was psychiatric and abuse related. As the method in this investigation is based on data gathered from in hospital care records the registration of such problems may be claimed to be more accurate than for situations where the pre-existing disease inquiries are made either by the trauma surgeon to the patients or by a questionnaire as was partly done in the present study and where there is a significant risk that the patients may be assumed underreport issues of psychiatric and abuse origin.

Despite pre-existing diseases many patients returned to work. In the present study 49 (45%) of the patients were on sick leave six months after the trauma, which declined to 18 (17%) at 24 months. Other studies have shown that 36%-47% of their patients were unable to work 12 months after the trauma,^(34, 35) and about 20% for up to five years after the trauma.^{(28, 32),30} These data support the fact that our trauma group does not seem to be significantly different in these aspects

in comparisons of HRQoL from other patients in ICU and control groups. When we compared the HRQoL of our trauma group with those of healthy control groups, we found the same results as in other studies, that is, the trauma group had a reduced HRQoL in all dimensions of SF-36.³² In our investigation we also included sociodemographic data as it is well known to affect HRQoL.² This was also our finding but these effects were rather small (effects in only 2 dimensions out of 40 (RP and BP)). However, we think it is important that they are included to improve the whole analysis model. The new approach and findings in the present study are related to the comparison of HRQoL in the trauma group with a control group in the uptake area of the hospitals, and adjusting for the prevalence of pre-existing diseases.

Effects of trauma and ICU related factors

Although Sluys et al found that ISS had an effect on HRQoL in five dimensions of SF-36⁽²⁾, if ISS was in the range of 16-24 we found no such effects. Our findings are in line with Holtslag et al, who described a group of patients who were similar to ours.⁽²⁸⁾ Ringdal et al found that APACHE II scores affected HRQoL in one physical and two mental dimensions of SF-36⁽²⁶⁾, and we found effects in two of the mental dimensions. These findings are difficult to explain as: the APACHE II scores that we recorded are low, and in our other studies on critical ill patients even high APACHE II scores did not have an effect on HRQoL¹⁵. This is contradicting our study where we found a small effect of APACHE II on HRQoL in the dimensions (Vitality and Mental health). Length of stay in ICU did not affect HRQoL in our trauma patients. This is in line what we have previously presented for ICU patients.⁽¹³⁻¹⁵⁾ but is contrary to the findings of Ringdal et al who found a correlation between longer stay in ICU and worse physical function and limitations of roles as a result of physical problems.^(26, 30) This outcome may be due to a shorter follow-up period in that study²⁶. As far as maximum SOFA score was concerned, we found

effects mainly in the dimension of physical function, a finding similar to that we have seen for patients in ICU with diagnoses other than trauma.⁽¹³⁾ This is also supported by the data of Ringdal et al.⁽²⁶⁾

Conclusions

The new and important finding in this study is that the trauma population seems to have a trauma specific HRQoL outcome pattern. The most pronounced reduction was seen early in physical health and this normalized during the two years follow-up after the injury. The effects of pre-existing diseases were significant and most pronounced in the mental health related dimensions of the SF-36. This may be due to the fact that the most prevalent pre-existing disease group among the trauma patients was psychiatric diagnoses and abuse related.

Acknowledgement

We thank Ebba Lunden for collecting the data, Olle Eriksson for statistical advice, and Mary Evans for the English revision of the manuscript. We are also grateful to the Linquest Group at the Centre for Public Health at the County Council of Östergötland for providing access to the data for the reference group

References

1. Niskanen M, Kari A, Halonen P. Five-year survival after intensive care--comparison of 12,180 patients with the general population. Finnish ICU patients. *Crit Care Med* 1996;24:1962-1967.
2. Sluys K, Häggmark T, Iselius L. Outcome and quality of life 5 years after major trauma
J Trauma 2005;59:223-232.
3. Ulvik A, Kvåle R, Wentzel-Larsen T, et al. Quality of life 2-7 years after major trauma
Acta Anaesthesiol Scand 2007;52:195-201.
4. Eddleston J, White P, Guthrie E. Survival, morbidity, and quality of life after discharge from intensive care. . *Crit Care Med* 2000;28:2293-2299.
5. Kleinpell RM. Exploring outcomes after critical illness in the elderly. *Outcomes Manag* 2003;7:159-169.
6. Wehler M, Geise A, Hadzionerovic D, et al. Health-related quality of life of patients with multiple organ dysfunction: individual changes and comparison with normative population. *Crit Care Med* 2003;31:1094-1101.
7. Graf J, Koch M, Dujardin R, et al. Health-related quality of life before, 1 month after, and 9 months after intensive care in medical cardiovascular and pulmonary patients. . *Crit Care Med* 2003;31:2163-2169.
8. Pettila V, Kaarlola A, Makelainen A. Health-related quality of life of multiple organ dysfunction patients one year after intensive care. *Intensive Care Med* 2000;26:1473-1479.
9. Garcia Lizana F, Peres Bota D, De Cubber M, et al. Long-term outcome in ICU patients: what about quality of life? *Intensive Care Med* 2003;29:1286-1293.
10. Vedio A, Chinn S, Warburton F, et al. Assessment of survival and quality of life after discharge from a teaching hospital general intensive care unit. *Clinical Intensive Care* 2000;11:39-46.
11. Badia X, Diaz-Prieto A, Gorriz MT, et al. Using the EuroQol-5D to measure changes in quality of life 12 months after discharge from an intensive care unit. *Intensive Care Med* 2001;27:1901-1907.
12. Hurel D, Loirat P, Saulnier F, et al. Quality of life 6 months after intensive care: results of a prospective multicenter study using a generic health status scale and a satisfaction scale. *Intensive Care Med* 1997;23:331-337.
13. Orwelius L, Nordlund A, Edell-Gustafsson U, et al. Role of preexisting disease in patients' perceptions of health-related quality of life after intensive care. *Crit Care Med* 2005;33:1557-1564.
14. Orwelius L, Nordlund A, Nordlund P, et al. Prevalence of sleep disturbances and long-term reduced health-related quality of life after critical care: a prospective multicenter cohort study. *Crit Care* 2008;12:R97.
15. Orwelius L, Nordlund A, Nordlund P, et al. Pre-existing disease: the most important factor for health related quality of life long-term after critical illness: a prospective, longitudinal, multicentre trial. *Crit Care* 2010;14:R67.
16. Eriksson E, Nordlund A. Health and health related quality of life as measured by the EQ-5D and the SF-36 in South East Sweden: results from two population surveys. Linköping; 2002.

17. Ekberg K, Noorlind Brage H, Dastserri M. Östgötens hälsa och miljö (Health and Environment 2000 in Östergötland) Sweden; (In Swedish). Centre for Public Health, County Council of Östergötland; 2000.
18. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992;30:473-483.
19. McHorney CA, Ware JE, Jr., Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Med Care* 1993;31:247-263.
20. Garratt A, Schmidt L, Mackintosh A, et al. Quality of life measurement: bibliographic study of patient assessed health outcome measures. *BMJ* 2002;324:1417.
21. Angus DC, Carlet J. Surviving intensive care: a report from the 2002 Brussels Roundtable. *Intensive Care Med* 2003;29:368-377.
22. Sullivan M, Karlsson J, Ware JE, Jr. The Swedish SF-36 Health Survey--I. Evaluation of data quality, scaling assumptions, reliability and construct validity across general populations in Sweden. *Soc Sci Med* 1995;41:1349-1358.
23. Baker S, O'Neil B, Haddon W, et al. The injury severity score: A method for describing patients with multiple injuries and evaluating emergency care. *J Trauma* 1974;3:187-196.
24. Vincent J, Moreno T, Takala J, et al. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. On behalf of the Working Group on Sepsis-Related Problems of the European Society of Intensive Care Medicine. *Intensive Care Medicine* 1996;22:707-710.
25. Moreno R, Vincent J, Matos R, et al. The use of maximum SOFA score to quantify organ dysfunction/failure in intensive care. Results of a prospective, multicenter study. *Intensive Care Med* 1999;25:686-696.
26. Ringdal M, Plos K, Lundberg D, et al. Outcome After Injury: Memories, Health-Related Quality of Life, Anxiety, and Symptoms of Depression After Intensive Care *J Trauma* 2008.
27. Korosec Jagodic H, Jagodic K, Podbregar M. Long-term outcome and quality of life of patients treated in surgical intensive care: a comparison between sepsis and trauma. *Crit Care* 2006;10:R134.
28. Holtslag H, Post M, van der Werken C, et al. Return to work after major trauma *Clin Rehabil* 2007 21:373-383.
29. Andersson R, Aaronson N, Wilkin D. Critical review of the international assessments of health-related quality of life. *Quality of Life Research* 1993;2:369-395.
30. Ringdal M, Plos K, Lundberg D, et al. Outcome after injury: Memories, health-related quality of life, anxiety, and symptoms of depression after intensive care. *The Journal of Trauma* 2008:1-8.
31. Sluys K, Häggmark T, Iselius L. Outcome and quality of life 5 years after major trauma. *J Trauma* 2005;59:223-232.
32. Ringdal M, Bergbom I. Memories and Health related Quality of Life. Institute of health and Care Sciences at Sahlgrenska Academy. Gothenburg: University of Gothenburg; 2008.
33. Nordström A, Bodlund O. Every third patient in primary care suffers from depression, anxiety or alcohol problems. *Nordic Journal of Psychiatry* 2008;62:250-255.
34. Dimopoulou I, Anthi A, Mastora Z, et al. Health-related quality of life and disability in survivors of multiple trauma one year after intensive care unit discharge. *Am J Phys Med Rehabil* 2004;83:171-176.
35. Michaels AJ, Michaels CE, Smith JS, et al. Outcome from Injury: General Health, Work Status, and Satisfaction 12 Months after Trauma *J Trauma* 2000;48:841-850.

