

Health-Related Quality of Life in Severely Injured Trauma Patients with Positive and Negative Blood Alcohol Level on Admission

Antti Riuttanen (✉ antti.riuttanen@gmail.com)

Tampere University Hospital <https://orcid.org/0000-0003-1112-5768>

Jarkko Jokihaara

Tampereen Yliopisto

Tuomas T. Huttunen

Tampereen Yliopisto

Ville M. Mattila

Tampereen yliopistollinen sairaala

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Abstract

Purpose

The objectives of this study were to evaluate whether pre-injury alcohol use has an influence on an injured patient's HR-QoL and reported problems.

Methods

Retrospective analysis of 227 severely injured trauma patients (age ≥ 18 years, NISS ≥ 16) treated at Tampere University Hospital's (TAUH) Intensive Care Unit (ICU) or High Dependence Unit (HDU) in 2013. HR-QoL was assessed with the EQ-5D questionnaire, and was further compared with index values of population norms of Finland.

Results

Patients with positive BAL expressed notably more anxiety and depression (45%) before trauma compared to both patients with negative BAL (11%) and the reference population (14%). Overall, pre-injury HR-QoL was also poorer in BAL positive patients than BAL negative patients. The amount of anxiety and depression in BAL positive patients decreased after injury. In both groups, the relative number of reported problems after injury exceeded the relative number of reported problems of the reference population in all five EQ-5D dimensions.

Conclusions

Patients with positive BAL upon admission report overall lower pre-injury HR-QoL than patients with negative BAL, which is most likely explained by the alcohol's negative effect on mental health. As reported anxiety and depression decreased one year after injury, we speculate that this may partly be explained by a possible reduction in alcohol use, which has been reported to happen in injury patients. As has previously been reported, the impact of severe injury on post-injury QoL in general is detrimental and long-lasting and overall HR-QoL remains lower than the population norm.

Plain Summary

The impact of severe trauma on Health-Related Quality of Life (HR-QoL) is detrimental and long-lasting. To provide better care for injury victims it is vital for health care provider to be aware of special problems that different injury victims may have.

Even though alcohol use among injury patients is common, the associations of alcohol use on HR-QoL have not previously been studied in severely injured trauma patients.

In this study we compared HR-QoL in injury victims with positive and negative blood alcohol level (BAL). We found out that patients with positive BAL expressed notably more anxiety and depression (45%) before trauma compared to both patients with negative BAL (11%) and the reference population (14%),

which is most likely explained by the alcohol's negative effect on mental health. Overall, pre-injury HR-QoL was also poorer in BAL positive patients than BAL negative patients. Interestingly, the amount of anxiety and depression decreased after injury. We speculate that this decrease may be partly explained by a possible reduction in alcohol use, which has been reported to be common in injury patients.

The results point out that patients with positive BAL may not fare worse in the long run, especially when they receive proper care for mental health issues.

Introduction

Every year, approximately 5 million people die worldwide as a result of various types of injuries (1). With improvements in trauma care and the subsequent decrease in trauma mortality, the focus of interest has shifted from mortality to non-fatal outcomes, such as Health-Related Quality of Life (HR-QoL) (2, 3).

During the last two decades, numerous studies concerning HR-QoL after injuries have been published. Moreover, it is well described that in both minor (4, 5) and severe injuries (6-10), the injury has a significant negative impact on the post-injury HR-QoL of the injured person. It is also apparent that the negative effect on HR-QoL after severe injury is a long-lasting condition/phenomenon (9, 11). It may be, however, that a person's psychosocial factors have more of an effect on post-injury HR-QoL than the injury pattern or the severity of the injury itself (6). Indeed, according to recent a Danish study, roughly one-fifth of injured patients can be diagnosed with post-traumatic stress disorder (PTSD) at one year after injury, regardless of whether the injury was minor or severe in terms of injury severity scores (12).

Frequent alcohol use is a known risk factor for various injuries (13-15) and also decreases overall quality of life (16, 17). From one third up to half of all injured patients admitted to emergency rooms have been shown to have a positive blood alcohol level (BAL) upon admission (13, 18-20). According to a Finnish study by Savola and colleagues, the majority of emergency room patients also express hazardous drinking patterns, such as binge drinking (21). However, despite the fact that alcohol use among injury patients is common, the associations of pre-injury alcohol use on HR-QoL have not previously been studied.

In this retrospective observational study, our primary objective was to evaluate whether pre-injury alcohol use influences pre- and post-injury HR-QoL or reported problems in severely injured patients. A secondary objective was to compare post-traumatic HR-QoL in those patients who used alcohol and those who did not with the population-based and age-stratified average of Finland.

Material And Methods

The study was conducted at Tampere University Hospital (TAUH), Finland. TAUH serves as a tertiary trauma care unit for the surrounding 3 hospital districts and it has a catchment area of approximately 900,000 inhabitants. TAUH provides a 24-hour in-house or immediate service in orthopaedic surgery,

neurosurgery, anaesthesiology and intensive care, emergency medicine, radiology, internal medicine, plastic surgery, oral and maxillofacial, paediatric and critical care.

Patient selection and inclusion/exclusion criteria

Flowchart of the patient enrolment process of study cohort is presented in Figure 1. All trauma-related admissions (n= 429) with injury-related 10th revision of the International Classification of Diseases and Related Health Problems (ICD-10) codes (S00 – T98) in the Intensive Care Unit (ICU) and High Dependency Unit (HDU) of TAUH in 2013 were retrospectively inspected for patient enrolment. Of these 429 admissions, we identified 373 unique patients aged 18 or over for further studies. The medical histories, laboratory tests and radiological examinations of these 373 patients were carefully reviewed. All injuries were scored by anatomically-based Abbreviated Injury Scale (AIS) (22) that classifies each injury to nine body regions. To assess injury severity, both the Injury Severity Score (ISS) (23) and the New Injury Severity Score (NISS) (24) were calculated based on the AIS scores. Severe injury was defined as NISS score of at least 16. The following inclusion criteria were used in our study: patient treated at TAUH's ICU or HDU, age \geq 18 years, NISS \geq 16, and possessing a valid Finnish personal identification number in order to enable comprehensive follow-up.

Of these 373 patients, we excluded 127 patients who had less than 16 NISS points and 10 patients who died during hospital stay or within 30 days of the incident. Three patients became organ donors and were also excluded. Of the remaining 233, patients who were foreign nationals (4) and patients who had since had sex reassignment therapy (2) were excluded because of missing or altered Finnish personal identification numbers. Thus, a total patient cohort of 227 patients was included in the study.

Figure 1. Flowchart of patient enrolment.

Assessment of alcohol use

All the patient's injury-related medical records and laboratory tests were reviewed for evidence of alcohol use prior to injury. Alcohol use was confirmed by means of a positive breath analyser or direct blood test. As stated by the Finnish Parliamentary Ombudsman in 2013, testing for alcohol in trauma patients in Finland has to be medically justified and not simply a norm (25). Patients with confirmed positive alcohol test were labelled as "BAL positive" (Blood Alcohol Level) and the rest were labelled as "BAL negative". To evaluate mean blood alcohol levels, direct blood alcohol levels were converted to g/L (1 g/L = 21.7 mmol/L).

Evaluation of Health-Related Quality of Life (HR-QoL)

The World Health Organization (WHO) defines Quality of Life as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their

goals, expectations, standards and concerns. Quality of life is therefore a broad ranging concept that is affected in a complex way by a person's physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment. (26)

Health-Related Quality of Life (HR-QoL) was evaluated with the EQ-5D-3L (27) questionnaire, which has been routinely used in Tampere University Hospital's ICU/HDU since 2008. The EQ-5D questionnaire is a 5-dimensioned tool that assesses the following 5 dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension has 3 levels: no problems, some problems and extreme problems. EQ-5D is a commonly used instrument in studies assessing HR-QoL after injuries (28) and is a simple set of questions that can be filled out by the patient or by their next of kin. During their stay in the ICU/HDU, all patients are asked to evaluate their health status concerning the time prior to admission. After one year, the patients are contacted again by a study nurse and asked to re-evaluate their current health status. If the patient is unable to fill out the forms, the questionnaire is given to the next of kin. The EQ VAS records the patient's self-rated health on a vertical visual analogue scale where the endpoints are labelled 'Best imaginable health state' and 'Worst imaginable health state'. The VAS can therefore be used as a quantitative measure of health outcome that reflects the patient's own judgement.

The EQ-5D results were converted into a single summary index using a country-specific EQ-5D VAS valuation method. This index value was further compared to the index values of age-matched population norms in Finland. As index values have not been validated for Finnish patients under 25 years, we used the index value of the 25-34 years age group (0.909) for the 11 patients who were under 25 years of age.

Assessment of education level

Level of education was defined as low, medium or high. Those with a low level of education had had at most 9 years of education (elementary school or less), those with medium level of education had spent 11 to 12 years in education (including matriculation examination, vocational qualifications attained in 1-3 years and further vocational qualifications) and those with a high level of education had had more than 12 years in education (for example polytechnic degrees, lower and upper level university degrees and doctoral education). Information on the education level of each individual patient was obtained from Statistics Finland (29), which is a national public authority for statistical data.

Statistics

Statistical analysis was performed with R Studio 3.5.3 with gmodels, ggplot2, xlsx and readxl extra packages. The χ^2 and Fisher's exact test were used for categorical variables; t-test was used for normally distributed continuous variables and Mann-Whitney test for not normally distributed variables. A p-value less than 0.05 was considered statistically significant.

Results

Demographics and mechanism of injury

Key demographics of the 227 trauma patients are presented in Table 1. The mean age of the patients was 53.9 years (SD 18.1, range from 18 to 91 years) and 74% of patients were male. The median ISS score in our sample was 17 (interquartile range 9) and NISS was 22 (interquartile range 10) for the whole study population. On average, the patients were treated in the ICU/HDU for 3.3 days. The majority of patients (84%, N= 190/227) required further treatment at a central or regional hospital after the initial hospital stay at Tampere University Hospital (52%, N= 117/227) or on a ward in a local primary health care centre (32%, N= 73/227).

Ninety-nine percent (N=225/227) of injuries were caused by blunt mechanism. Falling on the same level, stairs or from height caused 50% (N= 114/227) of the injuries. Thirty-four percent (N= 77/227) of injuries were caused by traffic accidents and 4.4% (N= 10/227) were self-inflicted, for example, by jumping from a building, in front of a train or self-stabbing. A further 3.1% (N= 7/227) of injuries were caused by intentional assaults.

Table 1
Demographics of ICU/HDU patients with

		All	Positive blood alcohol level (BAL+)		Negative blood alcohol level (BAL-)		
		n= 227	%	n= 77	%	n= 150	%
Age, mean (SD)		53.9 (18.1)	52.7 (15.8)	54.6 (19.3)			
Gender, male		164	74%	65	84%	99	66%
ASA (mean)	2.2	2.3	2.1				
Alcohol use							
Positive blood alcohol	77	34%	77	0	0%		
BAC (*) [g/L], mean	1.9	1.9	0				
Injury severity scores							
ISS, median (Q1-Q3)	17 (16 - 25)	17 (16 - 25)	17 (16 - 25)				
NISS, median (Q1-Q3)	22 (17 - 27)	25 (18 - 29)	22.5 (17 - 27)				
ICU days, mean (SD)		3.3 (4.4)	3.1 (3.3)	3.3 (4.8)			
Died within 1 year		29	13%	9	12%	20	13%
Mechanisms of injury							
Falls	114	50%	44	57%	70	47%	
Traffic accidents	77	34%	18	23%	59	26%	
Self-inflicted	10	4.4%	1	1.3%	9	6.0%	
Crush injuries	5	2.2%	0	0%	5	3.3%	
Assaults	7	3.1%	4	5.2%	3	2.0%	
Unspecified	14	6.2%	10	13%	4	2.7%	
Distribution of injuries, min AIS 2 (**)							
Head	140	62%	55	71%	85	57%	
Face	19	8.4%	3	3.9%	13	8.7%	
Neck	5	2.2%	1	1.3%	4	2.7%	

Thorax	70	31%	15	19%	55	37%
Abdomen	30	13%	6	7.8%	24	16%
Spine	73	32%	20	26%	50	33%
Upper extremity	41	18%	14	18%	27	18%
Lower extremity	44	19%	9	12%	35	23%
Education						
Low	91	40%	30	39%	67	45%
Middle	97	43%	37	48%	54	36%
High	39	17%	10	13%	29	19%
* BAC = Blood alcohol concentration (g/L)						
** AIS = Abbreviated Injury Score						

Alcohol use

Thirty-four percent (77/227) of all patients tested positive for alcohol at the time of the admittance with a mean blood alcohol content (BAC) of 1.9 g/L.

Health-Related Quality of Life (HR-QoL)

Twenty-nine patients (N= 29/227) died within 1 year of injury, and therefore only 198 patients could be contacted for post-injury EQ-5D questionnaires. In total, complete data sets with both pre- and post-injury EQ-5D questionnaires were available for 111 (56%) patients. Sixty-six patients (33%) were lost to follow-up and at least one answer was missing in 21 (11%) questionnaires, and were therefore excluded.

Alcohol and Health-Related Quality of Life (HR-QoL)

From the subgroup of 77 patients with positive BAL, a total of 31 (40%) had complete data sets with both pre- and post-injury EQ-5D questionnaires available for analysis (Table 2). Nine patients (12%) died within 1 year of trauma. One-third (35%, N= 27/77) of patients were lost to follow-up and 10 of the questionnaires (13%) had missing answers.

Patients with positive BAL experienced lower pre-traumatic HR-QoL than patients with negative BAL (0.835 vs. 0.920, $p= 0.03$). Similarly, the post-traumatic HR-QoL was also lower but the difference between the two groups was not statistically significant (0.727 vs. 0.768, $p= 0.43$). The mean decrease in HR-QoL

index after the injury was 0.108 and 0.151 for patients with positive and negative BAL, respectively. The difference between post-traumatic HR-QoL index and the age-specific population norm of Finland was minimal (-0.08 vs. -0.02, $p= 0.28$).

Table 2
Alcohol use and post-traumatic Quality of Life. Patients with complete EQ-5D data sets.

	Positive blood alcohol level (BAL+)		Negative blood alcohol level (BAL-)		p-value
	n= 31	28%	n= 80	72%	
QoL index, mean					
Age-specific population norm (x)	0.810		0.794		0.25
Pre-injury	0.835		0.920		0.03
Post-injury	0.727		0.768		0.43
Decrease	0.108		0.151		0.42
Pre-injury - population norm	0.023		0.125		0.01
Post-injury - population norm	-0.085		-0.025		0.28
(X) Population norms between groups vary due to age difference.					

Problems by dimensions

The reported problems by EQ-5D dimension before and after trauma with the population norm of Finland are displayed as a bar chart in Figure 1. One year after trauma, the main reported problems were most often related to pain and discomfort (57%), problems during usual activities (45%) or problems with mobility (44%). Almost half of the trauma patients in the current study reported having problems in these three dimensions one year after injury. The relative number of reported problems after injury exceeded the relative number of reported problems of the reference population of Finland in all five EQ-5D dimensions. Patients with positive BAL notably expressed more anxiety and depression (45%) before trauma compared with both patients with negative BAL (11%) and the reference population of Finland (14%). By contrast, patients with positive BAL reported less anxiety and depression after injury (35%).

Discussion

We are unaware of any previous study that has assessed the influence of alcohol use on the HR-QoL in severely injured patients. In our study, we found that in severely injured patients HR-QoL was lower before injury in those patients with positive BAL upon admission compared with those patients with negative

BAL. The reported HR-QoL one year after trauma was also lower in patients with positive BAL; however, the difference was not statistically significant. The overall decrease in HR-QoL was slightly lower in patients with positive BAL than in patients with negative BAL. When compared to age-specific population norms, patients with negative BAL upon admission reported notably higher pre-injury HR-QoL ($p= 0.01$) than patients with positive BAL. Age-specific population norms in both groups were similar. However, when comparing mean HR-QoL one year after injury to age-specific HR-QoL between the two groups, the difference was minimal.

One year after injury, the main reported problems by EQ-5D dimension were related to pain and discomfort or having problems during usual activities and with mobility. Almost half of the severely injured patients in the current study reported having problems in these three dimensions. Interestingly, patients who had positive BAL at admission, reported less anxiety and depression after injury than before. It remains unclear to which degree this finding is related to the post-traumatic condition and to possible changes in the individual's alcohol use. The mean blood alcohol content in the BAL positive trauma patients was 1.9 g/L, which is highly suggestive of hazardous drinking behaviour (21). In the other HR-QoL dimensions, the problems were less common before the injury than after.

It is a common occurrence that injury victims report pre-injury HR-QoL that exceeds age-specific population norms (30). In our study, this was, however, only apparent in patients with negative BAL, whereas in patients with positive BAL we noticed the opposite. As has been previously suggested (4, 9), we also noticed that post-injury HR-QoL remained lower than the age-specific population norm.

The potential negative impact of excessive alcohol consumption on a person's HR-QoL is well established (16, 17). Therefore, we propose that one possible explanation for the reported reduction in anxiety and depression could be a reduction in alcohol use after the injury happened. As has been previously shown by Pagulayan et al. (31), injured BAL positive patients often reduce their alcohol use after the injury, although it was not possible for us to verify this reduction.

One of the current study's obvious limitations is its retrospective nature. However, all the information about the patients' HR-QoL was prospectively collected during the patients' stay in ICU/HDU, and follow-up was done by phone by a study nurse. Patient inclusion to the study cohort was determined retrospectively by a pre-specified injury severity score (NISS) ≥ 16 , and data on alcohol use were retrospectively collected from the records.

After excluding patients that had died within one year of trauma, the total response rate for the study was 56%. It should be noted that when studying severely injured patient groups with a mortality rate of over 10%, even when patient survives for at least one year, the injury itself can be a limiting factor (for example, severe head trauma, etc.) that prevents further participation in the study protocols. A significant proportion of patients expressed a hazardous use of alcohol that could also have had effect on the attrition rate. Therefore, a response rate of 56% can be considered to be relatively satisfactory. Moreover, when comparing our response rate to that reported in earlier studies, it is clear that low response rates are

a common occurrence (4-6, 9) in studies regarding post-injury quality of life. Furthermore, the attrition rate has been shown to become even greater as time passes by (11).

The testing for alcohol in the current study was not systematic due to the constraints of Finnish legislation. This can therefore be considered a potential limitation and a source of inherent bias in study. Conversely, the rate of alcohol use in the whole study population (34%, mean BAC of 1.9 g/L) is in agreement with previous findings regarding alcohol use in various trauma patients (13, 19, 32). Furthermore, as the suspicion of alcohol use in trauma patients is usually high, we believe that it is unlikely that any significant alcohol use would have been missed by paramedics at the injury site or later by nurses and physicians in the ER or ICU. However, we acknowledge that this is a limitation and a possible source of bias.

As with all retrospective studies regarding post-injury quality of life, some common mechanisms of biases should be discussed. When pre-injury HR-QoL is measured after the incident, the evaluation is inherently at risk of recall bias, meaning that injury patients may remember their pre-injury HR-QoL better or worse than it actually was (33). Generally, the risk of recall bias grows as time passes. However, in the current study the data collection started early in the ICU/HDU, which is likely to have reduced the risk of recall bias. Injury victims are also at risk of transition shift, meaning that the victims' perceptions of HR-QoL are altered because of a change in the victims' internal standards, values and conceptualisation (34).

The definitive strength of this study is that all data on HR-QoL were prospectively collected at the ICU/HDU of a single large hospital that is responsible for all the major trauma patients in its catchment area. In like manner, the data collection started at the earliest possible time in the ICU/HDU, which is likely to have reduced the risk of recall bias. Furthermore, despite a somewhat limited response rate, a great deal of effort was made to contact patients one year after injury. HR-QoL was evaluated with the EQ-5D questionnaire, which is widely used generic instrument. EQ-5D is also easy to complete and it is a commonly used and accepted instrument for the evaluation of post-injury QoL.

Conclusion

To the best of our knowledge, no other study has compared HR-QoL in injury victims with positive and negative BAL. Roughly one-third of the patients in our study had positive BAL upon admission, with a mean BAC of 1.9 g/L. Overall, we found that patients with positive BAL upon admission experienced poorer pre-injury HR-QoL than patients with negative BAL. Post-injury HR-QoL in BAL positive patients was also lower than post-injury HR-QoL in BAL negative patients, but the difference was not statistically significant. Most notably, those patients with positive BAL reported excessive amounts of anxiety and depression both compared with patients with negative BAL and the general population in Finland. Interestingly, the amount of anxiety and depression decreased after injury. We speculate that this decrease may be partly explained by a possible reduction in alcohol use, which has been reported to be common in injury patients. As has been previously reported, the impact of severe injury on post-injury QoL in general is detrimental and long-lasting. As the current study suffers some limitations, especially related

to the limited number of patients, a similar study should be conducted with a larger population and with a longer follow-up time. Furthermore, it would be interesting to compare the findings of such a study with those of similar studies conducted in different countries.

Declaration

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Competing interests

The authors declare they have no competing interests.

Ethics approval and consent to participate

The current study is a registry study and does not require ethics approval, as stated by Regional Ethics Committee of the Expert Responsibility area of Tampere University Hospital, Finland.

Consent for publication

Not applicable.

Availability of data and materials

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

Authors' contributions

AR conceived of the study, collected data, performed statistical analysis and drafted the manuscript.

JJ participated in the design, helped with statistical analysis and participated in the writing process of the manuscript.

TH participated in data collection and in the writing process of the manuscript.

VM participated in the design and coordination of the study and helped draft the manuscript.

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Appendix

Differences between responders and non-responders

The differences between responders (111/198) and non-responders (87/198) are presented in Table 3. The responders did not differ statistically from non-responders according to age or injury severity scores. However, the responders were less likely to have a positive BAL (28% vs. 43%, $p=0.03$); had a higher level of education (high education level 26% vs. 9.2%, $p=0.008$); were more often pensioners (46% vs. 34%, $p=0.008$) and thus less likely to be unemployed (8.1% vs. 28%). The injury patterns between responders and non-responders did not differ.

Table 3. Differences between responders and non-responders, n= 198.						
		Responders		Non-responders		
		n= 111	%	n= 87	%	p-value
Gender						
	Male	76	68%	70	80%	0.057
	Female	35	32%	17	20%	
Alcohol use						
	Yes	31	28%	37	43%	0.03
	No	80	72%	50	57%	
NISS, median (Q1-Q3)						
		22 (17.5 - 27)		24 (17 - 30)		0.36
Age, mean (SD)						
		53.6 (17.7)		49.2 (18.0)		0.09
Education (*)						
	Low	41	37%	35	40%	0.008
	Medium	41	37%	44	51%	
	High	29	26%	8	9.2%	
Socioeconomical status (+)						
	Students	8	7.2%	4	4.6%	0.008
	Manual workers, lower-level employees and self-employed	23	21%	17	10%	
	Upper-level employees with administrative, managerial,	20	18%	12	14%	

professional and related occupations				
Pensioners	51	46%	30	34%
Unemployed/unknown	9	8.1%	24	28%
At least one injury in AIS region (min. AIS 2)				
Head	65		53	0.911
Neck	2		2	
Face	9		8	
Thorax	34		34	
Abdomen	19		11	
Spine	38		24	
Upper extremity	21		18	
Lower extremity & pelvis	21		23	

Abbreviations

AIS = Abbreviated Injury Scale

BAC = Blood Alcohol Concentration

BAL = Blood Alcohol Level

HDU = High Dependency Unit

ICU = Intensive Care Unit

ISS = Injury Severity Score

LOS = Length of Stay

MAIS = Maximum Abbreviated Injury Score

NISS = New Injury Severity Score

TAUH = Tampere University Hospital

Figures



Figure 1

Flowchart of patient enrolment

Reported problems by EQ-5D dimensions with population reference of Finland, BAL+ vs. BAL-
BAL-(n=80) BAL+(n=31)

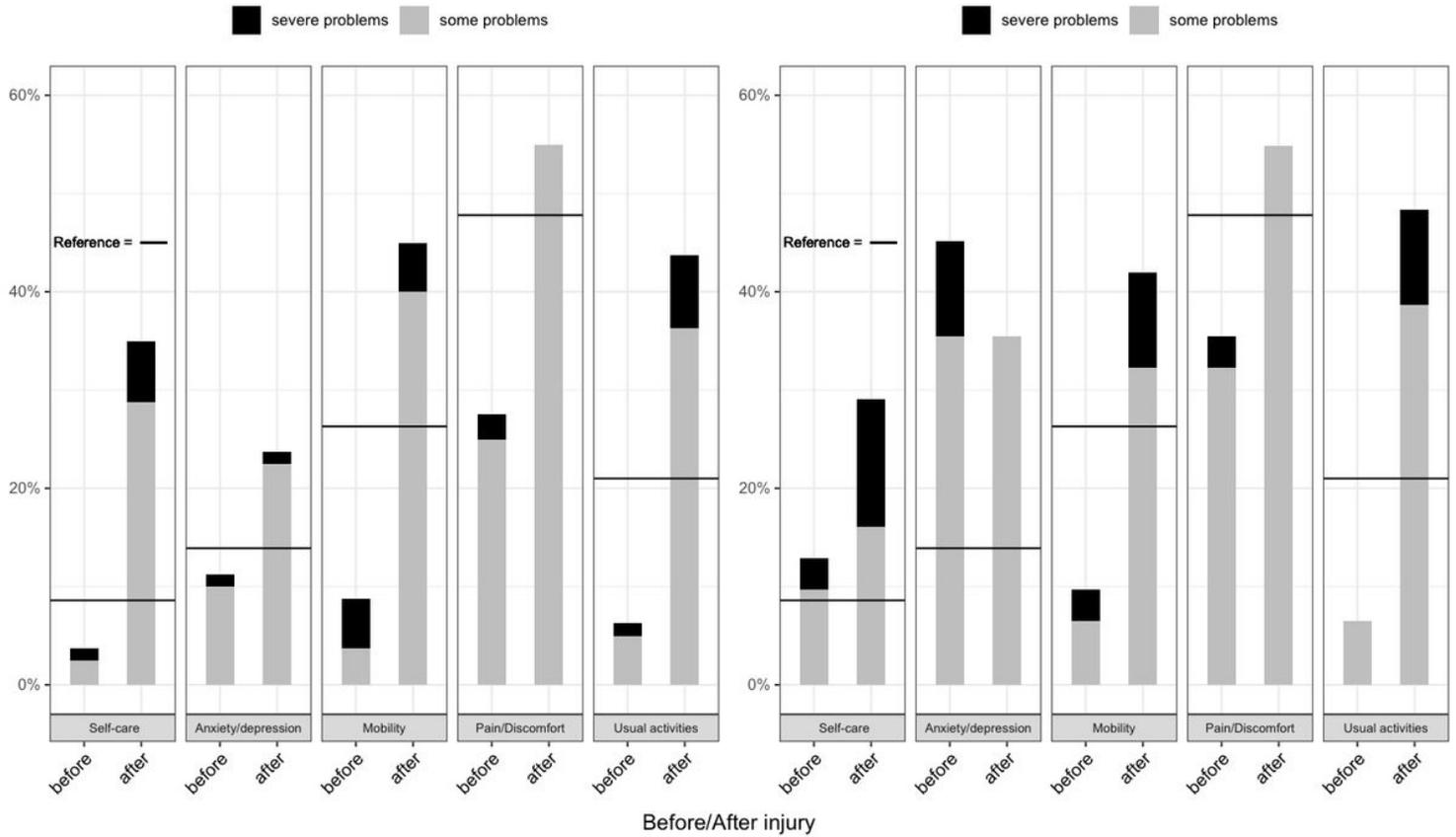


Figure 2

Reported problems by EQ-5D dimensions with population reference of Finland. BAL+ = patients with positive blood alcohol level BAL- = patients with negative blood alcohol level

Supplementary Files

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