

# Trauma and psychiatric disorders: A systematic review

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<b>BACKGROUND:</b>	Suicide is currently a topic of high priority for policy-makers, researchers and clinicians. The World Health Organization estimated 804,000 suicide deaths worldwide in 2012. Some studies that focused on patients with self-inflicted injury revealed that mortality in this group is higher than for patients who sustain unintentional injury. However little is known about the impact of psychiatric disorders on health care resources including length of hospital stay.
<b>OBJECTIVES:</b>	To determine whether trauma patients with a psychiatric disorder or after attempting suicide are at higher risk of a complicated course than patients without a psychiatric disorder or accidental cause. The secondary objective was to provide an overview of the current literature on the same group of trauma patients with psychiatric comorbidity in regard to mortality rate, length of stay, hospital costs and quality of life. Our primary outcome measure, complicated course, was found to be most clinically relevant.
<b>METHODS:</b>	We searched PubMed, Embase and PsycInfo electronic databases. All searches were updated to March 2016. The methodological quality was assessed using the QUIPS tool.
<b>RESULTS:</b>	Our search identified 9284 articles (PubMed 3660, Embase 2590, PsycInfo 3034). Of these, 18 articles were included. Four studies investigated the association between psychiatric disorders and a complicated course after trauma, three found a significant higher risk of complications. Mortality was reviewed in 14 studies, of which seven showed significant higher risk of in-hospital mortality for trauma patients with psychiatric disorder. Eight of nine studies found significant prolonged length of stay for these patients.
<b>CONCLUSION:</b>	Patients who have a psychiatric disorder or who have attempted suicide are at higher risk of increased in-hospital mortality and prolonged length of stay after sustaining injuries. These patients also tend to be at higher risk of complications after severe trauma, however future research is needed to confirm these potentially important implications. ( <i>J Trauma Acute Care Surg.</i> 2017;82:794–801. Copyright © 2017 Wolters Kluwer Health, Inc. All rights reserved.)
<b>LEVEL OF EVIDENCE:</b>	Systematic review, level III.
<b>KEY WORDS:</b>	Psychiatric disorders; psychiatric comorbidity; trauma patients; complications.

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The incidence of psychiatric disorders in trauma patients, excluding studies on suicidality, ranges from 20% up to 26%.<sup>1–3</sup> The majority of these studies focused on patients with self-inflicted injury and revealed that mortality in this group is higher than for patients who sustain unintentional injury.<sup>4–6</sup> In addition, trauma patients with a psychiatric disorder or after attempting suicide could be at higher risk of a complicated course than patients without a psychiatric disorder or accidental cause.<sup>1,7</sup> One study identified psychiatric disorders as an independent risk factor for unintentional injury and injury recidivism.<sup>3</sup> A high prevalence of psychoactive substance use disorders among seriously injured trauma patients was also reported.<sup>8,9</sup> As a result, it has become apparent that psychiatric comorbidity has a significant impact on health care resources including length of hospital stay.<sup>10,11</sup> Weinberg et al.<sup>12</sup> found depression to be an independent risk factor for sustaining a postoperative complication and conclude that complex interactions exist among mental health, coping mechanisms, and biomechanical stress signaling pathways.

Suicide is currently a topic of high priority for policy makers, researchers, and clinicians. The World Health Organization estimated 804,000 suicide deaths worldwide in 2012. They adopted the first-ever Mental Health Action Plan with the aim of reducing suicide rates in countries by 10%.<sup>13</sup> A road map for suicide research and prevention providing a four-point plan has recently been published in *Nature*.<sup>14</sup> They state that a lack of suicide research may be due to cultural taboos, the fact that causes of suicide are complicated and multifactorial, and suicidal behavior could be difficult to study if non-fatal attempts differ in etiology from fatal ones.<sup>14</sup> To our knowledge, neither psychiatric disorders nor suicidal attempt in trauma patients has been systematically reviewed before.

## Objectives

The primary objective of this review was to determine whether trauma patients with a psychiatric disorder or after attempting suicide are at higher risk of complications than patients without a psychiatric disorder or accidental cause.

The secondary objective was to provide an overview of the current literature on the same group of trauma patients with psychiatric comorbidity in regard to mortality rate, length of stay, hospital costs, and quality of life. Our primary outcome measure, complicated course, was found to be most clinically relevant.

## PATIENTS AND METHODS

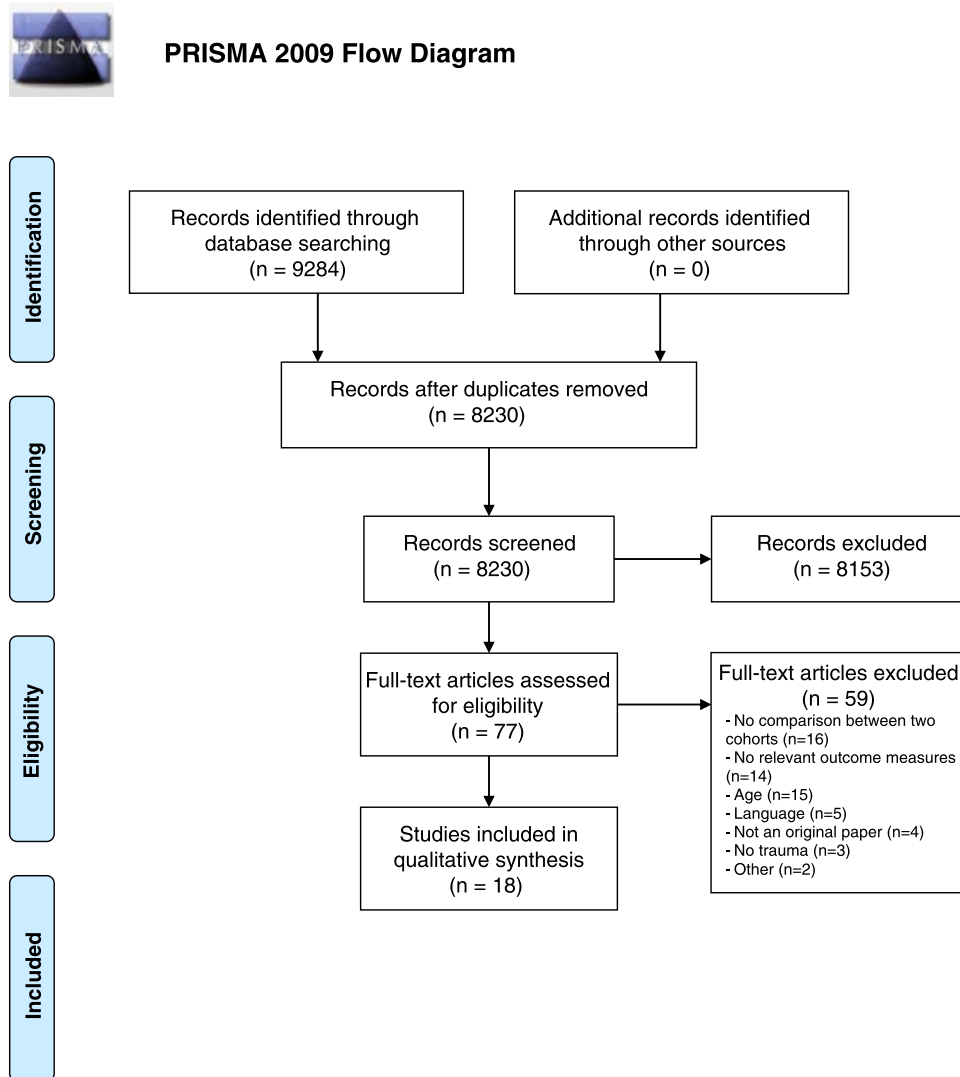
This study follows the recommendation of the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). No previous review protocol has been published.

### Eligibility Criteria

All observational cohort studies were considered eligible for inclusion if they reported differences in outcome after trauma for patients with psychiatric disorder or attempted suicide, as compared with patients without psychiatric disorder or accidental cause. Randomized controlled trials were not to be expected due to ethical considerations and case-control studies were excluded because of weakening the external validity and making it difficult to compare results by incidence or prevalence. All cases had to be 16 years or older. If no age range was given, study authors were contacted to confirm no children were included. We had intended to focus on cohort studies with a minimum follow-up of 3 months, however as no studies with this follow-up existed; therefore, we dismissed this inclusion criterion. The language of publication was limited to English, German, or Dutch. No limits for year of publication were applied.

### Information Sources and Search

We searched the following electronic databases: PubMed [www.ncbi.nlm.nih.gov] late 1940s to March 9th 2016, Embase (Ovid SP) 1947 to March 9th 2016, and PsycInfo (Ovid SP) 1806 to March 9th 2016. The search was conducted with the help of an experienced librarian and not restricted by date, language or publication status. Full details of the search strategies



**Figure 1.** Study flow diagram.

can be found in Supplemental Digital Content 1 (<http://links.lww.com/TA/A883>).

### Study Selection and Data Extraction

Two authors (E.C. and K.B.) independently screened the titles and abstracts identified by the search to determine which studies met the eligibility criteria. In case of doubt or disagreement, the full article was obtained for inspection. Full text copies of all potentially relevant studies were obtained and independently assessed by EC and KB to determine whether they met the inclusion criteria.<sup>15</sup> All eligible study records were stored using electronic bibliographic software (Endnote XI). Using a designed data extraction form, the following variables were extracted from the included studies: general characteristics, number of groups and our primary or secondary outcome measures. Authors were contacted for missing data where appropriate.

### Assessment of Risk of Bias

The methodological quality was independently assessed by two authors (EC and KB). The QUIPS tool (Quality in

Prognostic Studies) was used to assess the risk of bias. The QUIPS tool evaluates six domains: study participation, study attrition, prognostic factor management, outcome measurement, study confounding and statistical analysis and reporting. Each criterion was judged “Yes” indicating low risk of bias, “No” indicating high risk of bias, or “Unclear” indicating either lack of information or uncertainty over the potential for bias. Plots of ‘Risk of bias’ were created in Review Manager. Within each domain all criteria had to indicate “Yes” with a maximum of one “Unclear” to result in low risk of bias. If one criterion indicated “No” or there was more than one “Unclear” it resulted in high risk of bias. Publication bias was acknowledged and assessed with a funnel plot.

### Statistical Analysis

The primary outcome “complications” and secondary outcome “mortality rate” were given as dichotomous data and compared by risk ratio. Secondary outcomes “length of stay,” “cost,” and “quality of life” were shown as continuous data and compared by difference in means and standard deviation. For

**TABLE 1.** Description of Included Studies

Reference	Year	Origin	Design	Cohorts	Patients (n)	Outcome	Level
Akkas et al.	2011	Turkey	Retrospective	Suicidal	8	Mortality	IV
				Accidental	36		
Anderson et al.	2011	Scotland	Retrospective	Self-harm	45	Length of stay	III
				Non-self-harm	483		
Aufmkolk et al.	1999	Germany	Retrospective	Suicidal	94	Complications	III
				Accidental	117	Mortality	
Aunon-Martin et al.	2012	Spain	Retrospective	Suicidal	42	Mortality	III
				Work-related	64		
Bennett et al.	2009	USA	Retrospective	Self-inflicted	1931	Mortality	III
				Assault	13508	Length of stay	
				Unintentional	123150		
Clous et al.	2015	Netherlands	Retrospective	Psychiatric	131	Complications	III
				Nonpsychiatric	376	Mortality	
						Length of stay	
David et al.	2007	France	Retrospective	Intentional	151	Mortality	III
				Assault	91	Length of stay	
				Unintentional	761		
Dickinson et al.	2012	United Kingdom	Retrospective	Deliberate	23	Mortality	III
				Accidental	42		
Lyons et al.	1988	USA	Retrospective	Psychiatric	17	Length of stay	IV
				Non-psychiatric	69	Cost	
Muakkassa et al.	2008	USA	Retrospective	Intoxicated and psychiatric	25	Complications	III
				Intoxicated not psychiatric	25	Length of stay	
				Not intoxicated nor psychiatric	25		
Posel et al.	1998	Canada	Retrospective	Psychiatric	60	Mortality	III
				Trauma group-at-large	609	Length of stay	
Ruchholtz et al.	1996	Germany	Prospective	Suicidal	26	Mortality	IV
				Accidental	22		
Teh et al.	2003	United Kingdom	Retrospective	Jumpers	57	Mortality	III
				Fallers	342		
van der Does et al.	1997	Netherlands	Retrospective	Psychiatric	108	Mortality	IV
				Self-inflicted	123	Length of stay	
				Accidental	200		
Varley et al.	2012	Australia	Retrospective	Intentional	98	Mortality	III
				Unintentional	2251		
Wan et al.	2006	USA	Retrospective	Psychiatric	347	Mortality	III
				Nonpsychiatric	1362	Length of stay	
Weinberg et al.	2016	USA	Retrospective	Psychiatric	104	Complications	III
				Nonpsychiatric	228		
Wisler et al.	2011	USA	Retrospective	Neuropsychiatric medication	245	Mortality	III
				No neuropsychiatric medication	467		

heterogeneity the  $I^2$  test of Higgins et al.<sup>16</sup> and the  $\chi^2$  test were used. All analyses were performed with Review Manager 5.3.

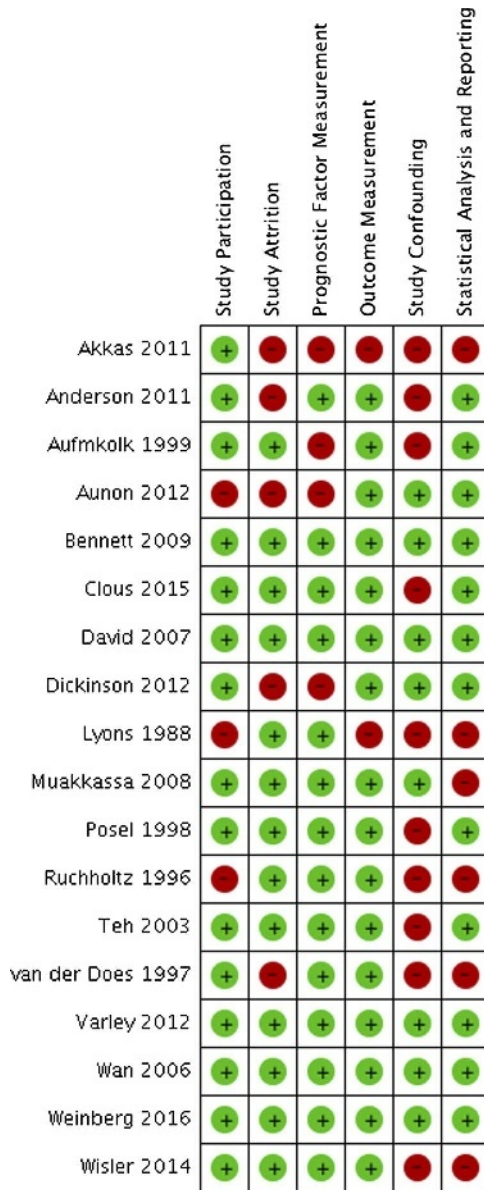
## RESULTS

Our search identified 9284 articles (PubMed 3660, Embase 2590, PsycInfo 3034). Of these, 1054 duplicates were removed. Title/abstract screening excluded 8153 articles, leaving 77 articles to be assessed for inclusion in full text. An additional 59 articles were subsequently excluded, resulting in total of 18 included articles (Fig. 1). All studies were observational cohort studies, 17 retrospective studies and 1 prospective study. Sample size varied from 44 to 138,589 patients with a median

of 415 (interquartile range, 83–785) patients (Table 1). Risk of bias was assessed with the QUIPS tool and summarized in Figure 2 and Supplemental Digital Content 2 (<http://links.lww.com/TA/A884>).

## Complications

Four studies reported an association between psychiatric disorders and a complicated course after trauma.<sup>1,7,10,12</sup> Two studies looked at outcomes after falls from height. One of these found that psychiatric disorders are an independent risk factor for a complicated course.<sup>1</sup> The other described a non-significantly higher number of complications in the group that fell accidentally.<sup>7</sup> The association with outcome



**Figure 2.** Risk of bias summary. Review authors' judgements about each risk of bias item for each included study.

of preinjury psychiatric medication in trauma patients was evaluated in one study, they found more respiratory complications.<sup>10</sup> A recent study investigated patients with femoral or axial skeleton fractures and showed a significantly higher postoperative complication rate for patients with a psychiatric disorder.<sup>12</sup> They also found depression to be an independent

predictor of complications. Studies could not be pooled due to substantial heterogeneity ( $I^2 = 86\%$ , Fig. 3).

**Mortality Rate**

The mortality rate of patients with intentional harm or psychiatric comorbidity was reported in fourteen studies.<sup>1-7,11,17-22</sup> In nine of these studies comparisons in cohorts were based on intent: intentional or unintentional.<sup>4-7,17-21</sup> Four studies made a comparison based on psychiatric comorbidity.<sup>1,3,11,22</sup> One study made a distinction between intent, psychiatric comorbidity and a control group.<sup>2</sup> The results “self-inflicted burns” and “psychiatric patients” were combined for this review. Seven studies found a significantly higher risk of mortality for patients with intentional harm or psychiatric comorbidity.<sup>1,2,4-6,19,21</sup> Four studies showed a trend toward a higher risk of mortality, where three studies showed a trend in the opposite direction. Studies could not be pooled due to substantial heterogeneity ( $I^2 = 86\%$ , Fig. 4).

**Length of Stay**

Nine studies reviewed the hospital length of stay.<sup>1-5,10,11,23,24</sup> In three of these studies comparisons in cohorts were based on intent: intentional or unintentional.<sup>4,5,23</sup> Five studies made a comparison based on psychiatric comorbidity.<sup>1,3,10,11,24</sup> One study made a distinction between intent, psychiatric comorbidity and a control group.<sup>2</sup> The results “self-inflicted burns” and “psychiatric patients” were combined for this review. One study found no significant difference, while the other eight studies described a significantly longer hospital length of stay for either the intentional or the psychiatric group. Studies could not be pooled due to substantial heterogeneity ( $I^2 = 93\%$ , Fig. 5).

**Hospital Costs**

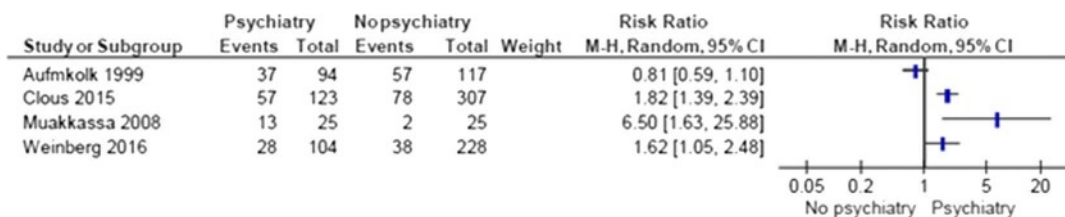
Only one study examined a difference in hospital costs.<sup>24</sup> Length of stay and the effects on expenses on a specialized unit for spinal cord injuries was compared between acute psychiatric consultations and matched nonpsychiatric cases. Although the average charge for the psychiatric consultations group was higher than for the matched group, this result was statistically insignificant.

**Quality of Life**

No studies reported data on this outcome.

**DISCUSSION**

In this review we examined whether trauma patients with a psychiatric disorder or after attempting suicide were at higher risk of a complicated course, mortality rate, length of stay, hospital costs, and quality of life.



**Figure 3.** Complications. Forrest plot for included studies on complications. Random effects model. M-H = Mantel-Haenszel.

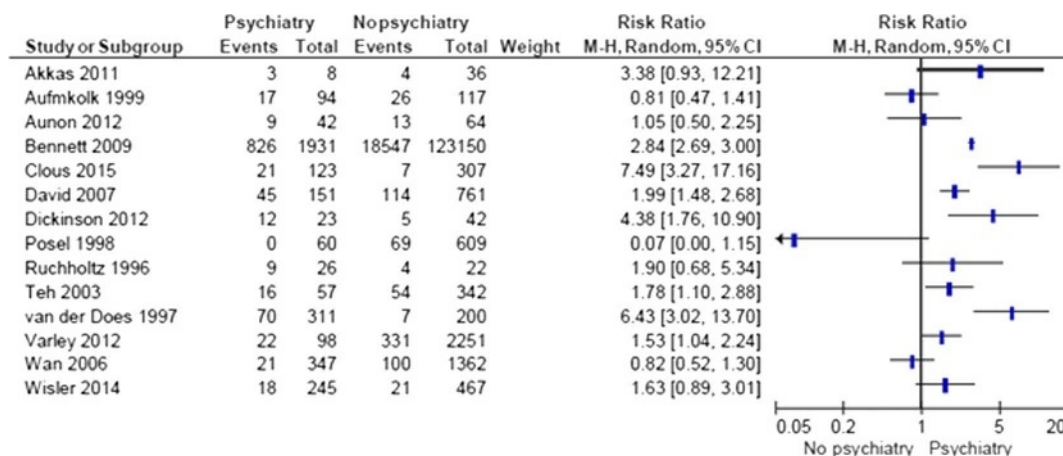


Figure 4. Mortality rate. Forrest plot for included studies on mortality rate. Random effects model. M-H = Mantel-Haenszel.

Some studies investigated outcome after a specific trauma mechanism: falls from height, train accidents, burn- or firearm-related injuries.<sup>1,2,6,7,17-19,21</sup> Other studies looked at intent: intentional versus unintentional harm.<sup>4,5,20,23</sup> Further studies compared two cohorts based on psychiatric comorbidity.<sup>3,10,11,22,24</sup> This review combined patients after attempted suicide with known psychiatric patients based on medication usage or chart review. We had to work with our own definition that every attempted suicide had to be part of a psychiatric disorder due to the violent mechanism chosen. Mean ages for all cohorts were around 30 to 40 years, with significant differences in age for the psychiatric cohort mentioned by van der Does et al. being lower, Varley et al. and Wan et al.,<sup>2,3,6</sup> being higher. The mean age in the study by Wisler et al.<sup>22</sup> was 63.5. This is not expected to have an effect on our results, because it was equal among both cohorts. All studies reported that the unintentional injury group was predominantly male, whereas in the intentional injury or psychiatric group there was a more equal gender distribution. This is conform sex distributions in a general trauma population.

With regard to our primary objective our review shows that psychiatric disorder or attempted suicide is likely to be associated with a more complicated course in trauma patients. Several mechanisms have been described explaining the link between psychiatric problems and adverse health outcomes after trauma. With regard to the more complicated course, Clous et al.<sup>1,6</sup> showed that psychiatric disorder is an independent risk factor for complications after trauma because of the possibility of a subconscious restraint amongst health care

providers or the reduced compliance of patients with a psychiatric disorder. Weinberg et al.<sup>12</sup> described depression as an independent risk factor for sustaining a postoperative complication and conclude that complex interactions exist among mental health, coping mechanisms, and biomechanical stress signaling pathways. They emphasize that their results only provide correlation and that the causation remains unclear. Muakkassa et al.<sup>10</sup> found that patients with a psychiatric disorder have more respiratory complications requiring mechanical ventilation. The reason for this may be that patients with psychiatric comorbidity require more medical sedation, making them more susceptible to aspiration pneumonia and respiratory failure. Although this study consisted of a small sample size, the results did reach statistical significance. The study by Aufmkolk et al.<sup>7</sup> did not find significant difference in complications. A subgroup analysis by Wisler et al.<sup>22</sup> showed a higher number of complications in patients taking antidepressants. In their overall group they studied neuropsychiatric medication, which included anti-epileptics in 2.8%. These patients do not meet our inclusion criteria for having a psychiatric disorder and absolute numbers for complications were missing, we therefore could not include this study for complications. The aim of the authors was to point out psychiatric medication can induce adverse reactions which have significant cardiac implications. A multivariate analysis was not performed to include maximum possible significant relationships and because of a small sample size in combination therapies.

Mortality was reviewed in fourteen studies, of which seven showed significant higher risk of in-hospital mortality

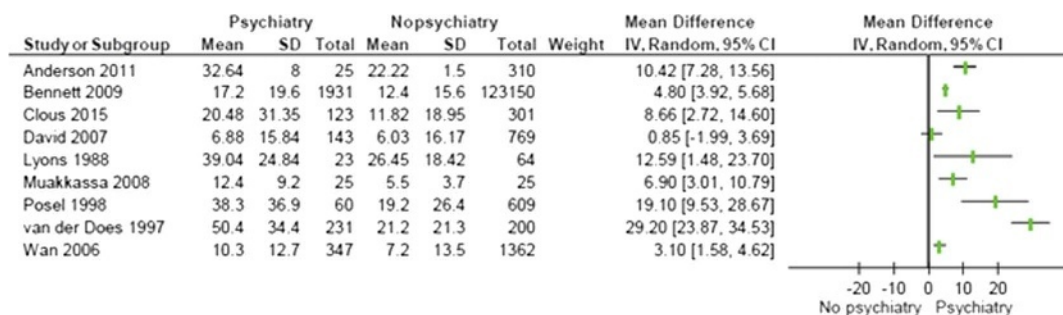


Figure 5. Length of stay. Forrest plot for included studies on length of stay. Random effects model. IV = Inverse Variance.

for trauma patients with psychiatric disorder. An interesting result presented by Posel and Moss<sup>11</sup> was that there were no deaths in the group of patients with psychiatric disorders, against 69 in the comparison group. The psychiatric group also had less severe injuries. Aufmkolk et al.<sup>7</sup> found an insignificant higher mortality rate for patients suffering accidental fall, which might be due to the fact that falls result in more head and thorax injuries than suicidal jumps. The majority of studies however seems to indicate a higher risk of in-hospital mortality for trauma patients with psychiatric disorder. An excluded but interesting study by Fazel et al.<sup>25</sup> examined the relationship between traumatic brain injury and premature mortality at 6 months. They found a threefold increased odds of mortality compared with general population controls, even from external causes like suicide, injuries and assault. These risks were substantially elevated with any psychiatric or substance abuse comorbidity.

Eight of nine studies found significant prolonged length of stay for patients with psychiatric comorbidity or those with intentional injury. Reasons given for this difference are poorer physical state due to self-neglect associated with psychiatric disorders, increased severity of self-inflicted injuries, complicated course and higher need for placement to a psychiatric or rehabilitation clinic.<sup>1-4,10,11,23,24</sup> One other studies did not find a significant difference, although it did show a trend toward prolonged length of stay for the psychiatric group.<sup>5</sup>

Just one study that reviewed hospital costs. Lyons et al.<sup>24</sup> found no significant differences in hospital costs, but determined that the length of stay was significantly longer for the psychiatric group. The authors provide two possible explanations: the first being that the study may be underpowered, and second, that psychiatric comorbidity is associated with lengthened hospital stay, but negatively associated with other hospital costs. This study published in 1988 did not describe the method to calculate hospital costs. Almost 30 years on, the absolute numbers will be irrelevant; however, the association could still be current. It is likely that differences in length of stay result in higher expenses for patients with psychiatric comorbidity. A more recent study by Zatzick et al.,<sup>26</sup> excluded because it did not meet our inclusion criterion "age," investigated the association between psychiatric disorders and direct hospital inpatient costs and length of stay. They found that inpatient costs were uniquely impacted by psychiatric comorbidity. Additional research of the processes and outcomes of care could lead to more cost-effective performance improvement efforts.

Another explanation of adverse health outcomes in trauma patients with psychiatric problems can be found in the effects of the traumatic event itself on the worsening or development of adverse mental health reactions like posttraumatic stress disorder as well as physical morbidity.<sup>27-29</sup> The trauma itself sets off a chain of psychological neuroendocrine stress reactions that may not only lead to mental health problems but also impair immune functioning and impact the recovery process.<sup>30</sup>

No studies were included that reviewed Quality of life. However, Michaels et al.<sup>31-33</sup> published multiple articles that showed the independent significance of psychological comorbidity as a factor impeding return to functional employment and compromising self-reported perceived general health at 6 and 12 months of follow-up. O'Connor et al.<sup>34</sup> documented that mental health functioning, depression symptoms, and history of mental

health services were associated with suicidal ideation in the hospital. They suggest to reduce the overall rate of suicide and suicide attempts by targeting these at-risk populations. Holbrook et al.<sup>35</sup> examined the association of several risk factors like depression and level of social support with functional limitation after trauma measured by the Quality of Well-being scale. A high incidence of post-injury depression was found in a relatively small sample of participants, this made an important contribution to functional limitation after major trauma. The same authors used this scale to provide new evidence that major in-hospital complications have an important impact on functional limitation after trauma as well.<sup>36</sup> Significant impairment across all functional outcomes was once more highlighted in a national US study by Zatzick et al.,<sup>37</sup> in which a dose-response relationship was observed.

There are several limitations to this review. The included studies have a high risk of bias in relation to its design and methodology. In addition, it was not possible to pool data from studies due to substantial heterogeneity, and as such, no meta-analyses could be performed. And finally, publication bias can be assumed to affect the outcome. Articles that investigated the relationship between psychiatric comorbidity and trauma that found no difference in outcome, are less likely to have been published. We therefore expect an overestimation of the effect. Assessment of the occurrence of publication bias with the use of a funnel plot was not possible due to substantial heterogeneity and differences in population and outcome measures of the included studies. However, despite these limitations, the broad, systematic search strategy in three major databases, executed by two authors independently, should provide a reliable overview of the current available literature. We wish to emphasize that a psychiatric disorder or attempted suicide can have a major impact on the care provided by specialties other than that available in trauma units. Therefore, it is of the utmost importance that good collaboration between health care providers exists and that further research focuses not only on suicidality in general but also considers the effect it might have on the outcome after trauma or other diseases, for example, PTSD or depression, including the worsening of mental health problems. Screening and early intervention based on psychological and biological risk factors for mental health disorders may prevent a chronic course of adverse health problems and potentially improve physical recovery of traumatic injury.<sup>38-40</sup>

## CONCLUSION

Patients who have a psychiatric disorder or who have attempted suicide are at higher risk of increased in-hospital mortality and prolonged length of stay after trauma. These patients tend to be at higher risk of complications after severe trauma; however, future research is needed to confirm these potentially important implications. Pooling of data could not be performed due to substantial heterogeneity. It is safe to assume that prolonged length of stay leads to higher hospital costs. Several mechanisms have been described explaining the link between psychiatric problems and adverse health outcomes after trauma. A good collaboration between health care providers from different specialties is essential to deal with these complicated issues.

## AUTHORSHIP

E.A.C. participated in the study design, literature search, data collection, data analysis, data interpretation, writing. K.C.B. participated in the study design, literature search, data collection, data analysis, data interpretation, writing. K.J.P. participated in the critical revision. J.S.K.L. participated in the study design, critical revision. M.O. participated in the writing, critical revision. J.C.G. participated in the study design, critical revision.

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## DISCLOSURE

The authors declare no conflicts of interest.

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