

University of Groningen

Prediction of outcome following mild traumatic brain injury

de Koning, Myrthe Elisabeth

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2017

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

de Koning, M. E. (2017). *Prediction of outcome following mild traumatic brain injury: From care to recovery*. [Thesis fully internal (DIV), University of Groningen]. Rijksuniversiteit Groningen.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

From miserable minority to the fortunate few: The other end of the mild traumatic brain injury spectrum



M.E. de Koning, BSc¹ *

M.E. Scheenen, MSc² *

H.J. van der Horn, MD, PhD¹ *

J.M. Spikman, PhD²

J. van der Naalt, MD, PhD¹

* Authors contributed equally

Department of Neurology¹ and Neuropsychology², University of Groningen, University Medical Center Groningen, The Netherlands

Submitted

ABSTRACT

Traditionally, almost all research endeavors on mild traumatic brain injury (mTBI) have been focused on the patients with residual complaints or have a suboptimal recovery. This so-called “miserable minority” is studied to potentially find factors leading to an unsuccessful recovery. However, no study so far has zoomed in on the remarkable patients that report zero complaints early after injury, a group that we named the “fortunate few”. Because nothing is known about this group and their further recovery trajectory, this study, as part of the prospective UPFRONT-study, aimed to describe their demographic, clinical and premorbid characteristics and to examine whether they would remain asymptomatic throughout the first year after injury. Moreover, we investigated the influence of anxiety and depression (HADS) and determined outcome (GOS-E) and quality of life (WHOQOL-BREF) one year after injury. Our sample consisted of 70 mTBI patients (Glasgow Coma Scale [GCS] score 13-15). There was considerable heterogeneity in recovery in this group, as more than half of patients (57%) developed complaints at a later stage ($M=2$, $p<.001$). These secondary complaints were related to higher levels of anxiety ($M=3.2$, $p=.004$) and depression ($M=1.4$, $p=.002$), leading to less favorable outcome ($p=.014$) and a lower quality of life ($p=.006$) one year after injury. We therefore conclude that even part of the fortunate few, who seem fully recovered early after injury, may develop secondary complaints leading to unfavorable outcome and lower quality of life, warranting further research of this interesting group.

INTRODUCTION

Research on mild traumatic brain injury (mTBI) particularly focuses on patients that show residual complaints or poor outcome.¹ However, no study so far has zoomed in on patients that report zero complaints at an early stage after injury. We argue that this is highly relevant, because these patients fall off the radar, with nothing known about their recovery trajectory. For example, it is not known whether these patients remain without complaints. Therefore, this group could be one of the missing links in the search for factors leading to successful or unsuccessful recovery after mTBI.

It is uncommon to report no complaints after mTBI.²⁻⁴ Interestingly, even healthy individuals without head injury often report similar complaints that are generally reported by mTBI patients, since these posttraumatic complaints (e.g. headache, concentration problems) are unspecific to mTBI.³ Frequencies of patients with zero complaints range from 6% within the first two weeks to 20% at one year post-injury.^{2,4} This implicates that this group is as big as the group reporting persistent complaints, also known as the 'miserable minority'.¹

Thus, this seemingly remarkable group deserves further scientific attention, which was the goal of this short communication. Specifically, we questioned whether patients with zero complaints would remain asymptomatic throughout the first year, and examined the influence of anxiety and depression, that have been found to be related to chronic complaints. Secondly, we determined the rates of favourable outcome and quality of life at one year post-injury.

METHODS

Participants were selected from the UPFRONT-study cohort, a prospective multicentre study on mTBI outcome in the Netherlands. At the emergency departments of three participating Level-1 Trauma centres, all mTBI patients aged 16 years or older were screened for inclusion. All patients meeting the inclusion and exclusion criteria were approached for participation. Detailed information on inclusion and exclusion can be found in a previous publication.⁵ Written informed consent was obtained from all participants, in compliance with the ethical regulations of our institute.

All participants of the UPFRONT-study received questionnaires at 2 weeks, 3, 6 and 12 months after injury, measuring posttraumatic complaints, mood, and outcome. The following questionnaires were used for the current study:

Head Injury Symptom Checklist (HISC).⁶ The HISC comprises 21 common posttraumatic complaints, which are rated on a pre-injury and post-injury level. For the current study, all participants that reported no complaints (i.e. compared to pre-injury) two weeks after injury were selected. This *no complaints* group was divided into two groups: (1) **Persistent no complaints (PnC)**: participants that reported no complaints throughout the follow-up (on all time measurements up to 12 months); (2) **Secondary complaints (SC)**: participants that started to report complaints during follow-up.

Hospital Anxiety and Depression Scale (HADS).⁷ The HADS is a commonly applied measure to screen for anxiety and depression after head injury. It measures 2 subscales of 7 questions each, with scores ranging from 0-21.

Glasgow Outcome Scale Extended (GOS-E).⁸ the GOS-E was administered as a measure of general functional outcome. The GOS-E defines outcome on an 8-point scale, ranging from dead (1) to complete recovery (8). Scores were dichotomized into incomplete recovery (scores 1-7) and complete recovery (8).

World Health Organization Quality of Life scale abbreviated version (WHOQOL-BREF): Quality of life was measured with the Dutch version of the WHOQOL-BREF.⁹ It contains 26 items, with scores ranging from 1-5 each. An overall Quality of Life score is calculated by summing up the first two items (overall quality of life and general health facet). The overall score, ranging from 2-10, was used as a general measure of quality of life.

Data were analyzed with the Statistical Package for the Social Sciences (SPSS 22.0, IBM SPSS Statistics, SPSS Inc, Chicago, IL). PnC and SC groups were compared using parametric (Student's t-test) and nonparametric tests (χ^2 , Mann-Whitney *U*). To investigate changes in HADS scores over time, a repeated measures ANOVA was performed on raw scores per subscale. Post-hoc mean comparisons were performed using univariate tests under the Bonferroni criterion. Alpha was set at 0.05, two-sided.

RESULTS

A total of 119 mTBI patients, 10% of the entire population (n=1151), reported no complaints 2-weeks post-injury (total). We lost 49 patients (41%) to follow-up. Patients that dropped out were significantly younger than patients that filled out all their questionnaires (39.7 vs. 53.1, $p < .001$). Of the remaining patients, 30 (43%) remained without complaints over the course of one year after injury (PnC), while 40 patients (57%) developed secondary complaints (SC) over time ($M=2$, range 0-10, $p < .001$ at 3, 6 and 12 months). Table 1 shows a comparison of the PnC group with the SC group. The groups differed with respect to gender and educational level. Patients in the PnC group were significantly younger in comparison to those in the SC group (46.3 vs. 58.2). They also had a higher

educational level than the secondary complaints group (5.7 vs. 4.9). No differences were found between groups with regard to gender, psychiatric history and measures of injury severity (GCS, ISS and CT-abnormalities).

Table 1. Patient demographic, clinical and premorbid characteristics

Variable	Total (n=119)	1) PnC (n=30)	2) SC (n=40)	Difference 1-2 statistic (df)	p
Male gender	92 (77)	25 (83)	28 (70)	$\chi^2=1.66$ (1)	NS
Age	47.6 (19.9) 16-89	46.3 (20.8) 17-88	58.2 (13.1) 23-79	$t=-2.74$ (46)	.009
Education	5.3 (1.1) 3-7	5.7 (1) 3-7	4.9 (1.1) 3-7	$U=354,5$.005
GCS score	14.6 (.67) 13-15	14.6 (.66) 13-15	14.7 (.45) 13-15	$U=591,5$	NS
Hospital admission (yes)	57 (48)	11 (36.7)	23 (57.5)	$\chi^2= 2.97$ (1)	NS
ISS (Injury Severity Scale)	6.2 (3.7) 0-19	5.1 (1.9)	6.1 (3.9)	$t=-1.23$ (39)	NS
CT abnormalities	9 (7.6)	1 (3.3)	3 (7.5)	$\chi^2= .55$ (1)	NS
Psychiatric history	0	0	0		

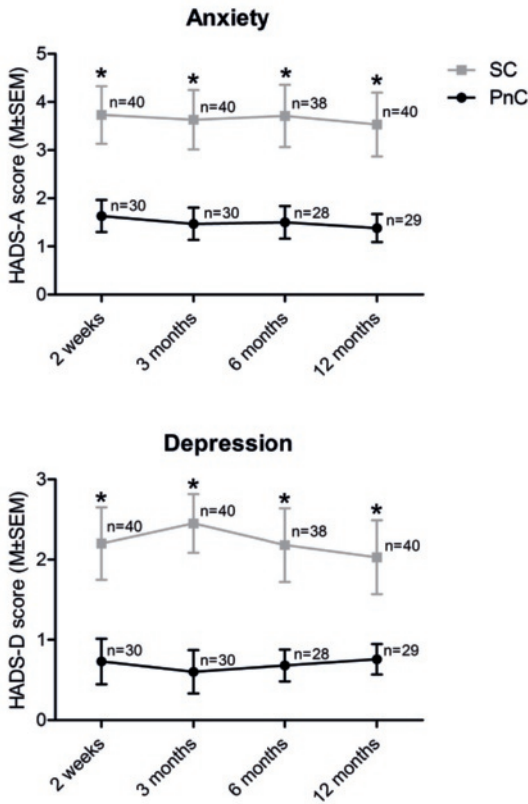
Mean (\pm SD), range; all others=number (%)

Anxiety and depression

Patients in the PnC group had significantly lower HADS-A ($M=3.2$, $p=.004$) and HADS-D ($M=1.4$, $p=.002$) scores than the SC group (Figure 1). Post-hoc tests showed significant group differences at every time point. No significant effect was found for time or time x group interaction.

Outcome and quality of life

At one year post-injury, 93% ($n=26$) of the PnC group showed favorable outcome compared to 68% ($n=25$) of the SC group ($\chi^2=6.03$, $p=.014$). Quality of life was also significantly higher in the PnC group compared to the SC group at one year post-injury (median: 9 vs. 8; $U=343$, $p=.006$).

Figure 1. Anxiety and depression scores over time in the PnC and SC groups

DISCUSSION

This is the first study that describes the ten per cent of patients with mTBI that report zero complaints early after injury, a group that we named the “fortunate few”. In current literature, it is generally assumed that these patients will remain without complaints and are therefore not followed-up. However, we observed that there exists considerable heterogeneity within this group, as more than half of these patients develop complaints at a later stage. These secondary complaints were related to higher levels of anxiety and depression, leading to less favorable outcome and a lower quality of life one year after injury. The patients that remained without complaints were younger and had a higher educational level when compared to the group that developed secondary complaints.

The far right end of the mTBI spectrum is constituted by the miserable minority, which is a group with persistent complaints and poor outcome.¹ This group is extensively studied;^{10–12} however, little to nothing is known about the other end of the spectrum. This

is a remarkable gap in knowledge, considering that it may be just as atypical to report no complaints at all.² Moreover, the belief that these patients are fully recovered early after injury and will remain complaint free is presumptuous and incorrect. We found that no less than 50% of this group develops complaints at a later stage. Remarkably, this subgroup already showed signs of psychological distress, reflected by higher scores of anxiety and depression, at two weeks post-injury. The fact that we found that the group that remained without complaints was younger and had a higher educational level can be explained by the robust finding that a younger age is associated with good recovery after mTBI.¹³ Higher educated patients may be better able to utilize adaptive coping strategies that prevent the secondary development of complaints.^{14,15} Interestingly, when regarding the total fortunate few group, none of the patients of the total fortunate few group had a psychiatric history. This in accordance with the literature, which reports psychiatric history to be a common risk factor for developing persisting complaints.¹

A limitation that needs to be addressed is the relatively large group of patients that was lost to follow-up. Although our dropout rate was comparable to other follow-up studies, we believe that the dropout of younger patients might have biased our results. It could be true that the percentage of patients that remain asymptomatic is larger than reflected by our results.

In conclusion, we demonstrated that some of the fortunate few, who seem fully recovered early after injury, may develop secondary complaints leading to poor outcome and lower quality of life. Therefore, the truly fortunate are in even fewer numbers than expected. We plead that more future mTBI research should be focused on early signs of psychological distress. This may be a better criterion to discern patients with optimal and non-optimal recovery than the presence of posttraumatic complaints, which holds important implications for clinical practice.

REFERENCES

1. Ruff, R. M., Camenzuli, L. & Mueller, J. Miserable minority: emotional risk factors that influence the outcome of a mild traumatic brain injury. *Brain Inj.* **10**, 551–65 (1996).
2. McMahon, P. *et al.* Symptomatology and functional outcome in mild traumatic brain injury: results from the prospective TRACK-TBI study. *J. Neurotrauma* **31**, 26–33 (2014).
3. Waljas, M. *et al.* A Prospective Biopsychosocial Study of the Persistent Post-Concussion Symptoms Following Mild Traumatic Brain Injury. *J. Neurotrauma* (2014).
4. King, N. S. Emotional, neuropsychological, and organic factors: their use in the prediction of persisting postconcussion symptoms after moderate and mild head injuries. *J. Neurol. Neurosurg. Psychiatry* **61**, 75–81 (1996).
5. Scheenen, M. E. *et al.* Patients 'At Risk' of Suffering from Persistent Complaints after Mild Traumatic Brain Injury: The Role of Coping, Mood Disorders, and Post-Traumatic Stress. *J. Neurotrauma* **34**, 31–37 (2017).
6. de Koning, M. E. *et al.* Subacute posttraumatic complaints and psychological distress in trauma patients with or without mild traumatic brain injury. *Injury* **47**, 2041–7 (2016).
7. Zigmond, A. S. & Snaith, R. P. The hospital anxiety and depression scale. *Acta Psychiatr. Scand.* **67**, 361–370 (1983).
8. Wilson, J. T., Pettigrew, L. E. & Teasdale, G. M. Structured interviews for the Glasgow Outcome Scale and the extended Glasgow Outcome Scale: guidelines for their use. *J. Neurotrauma* **15**, 573–585 (1998).
9. De Vries, J. & Van Heck, G. L. The World Health Organization Quality of Life Assessment Instrument (WHOQOL-100): Validation Study with the Dutch Version. *Eur. J. Psychol. Assess.* **13**, 164–178 (1997).
10. Lundin, A., de Boussard, C., Edman, G. & Borg, J. Symptoms and disability until 3 months after mild TBI. *Brain Inj.* **20**, 799–806 (2006).
11. Dischinger, P. C., Ryb, G. E., Kufera, J. A. & Auman, K. M. Early predictors of postconcussive syndrome in a population of trauma patients with mild traumatic brain injury. *J. Trauma* **66**, 287–289 (2009).
12. Ponsford, J., Cameron, P., Fitzgerald, M., Grant, M. & Mikocka-Walus, A. Long-term outcomes after uncomplicated mild traumatic brain injury: a comparison with trauma controls. *J. Neurotrauma* **28**, 937–946 (2011).
13. Jacobs, B. *et al.* Outcome prediction in mild traumatic brain injury: age and clinical variables are stronger predictors than CT abnormalities. *J. Neurotrauma* **27**, 655–68 (2010).
14. Lingsma, H. F. *et al.* Outcome prediction after mild and complicated mild traumatic brain injury: external validation of existing models and identification of new predictors using the TRACK-TBI pilot study. *J. Neurotrauma* **32**, 83–94 (2015).
15. Stulemeijer, M., van der Werf, S., Borm, G. F. & Vos, P. E. Early prediction of favourable recovery 6 months after mild traumatic brain injury. *J. Neurol. Neurosurg. Psychiatry* **79**, 936–942 (2008).

