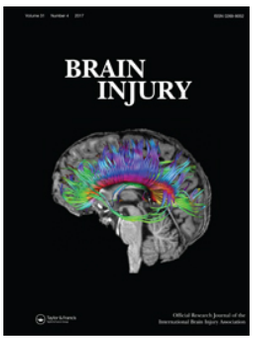

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ORIGINAL ARTICLE

Multidisciplinary outpatient treatment in patients with mild traumatic brain injury: A randomised controlled intervention study

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ABSTRACT

Objective: To evaluate the efficacy of a multidisciplinary outpatient follow-up programme compared to follow-up by a general practitioner for patients being at-risk or sick-listed with persistent post-concussion symptoms two months after a mild traumatic brain injury. *Design*: Randomised controlled trial. *Patients*: One hundred fifty-one patients, 16–56 years. *Methods*: Multidisciplinary outpatient rehabilitation with individual contacts and a psycho-educational group intervention at two outpatient rehabilitation clinics compared to follow-up by a general practitioner after the multidisciplinary examination. Primary outcome was sustainable return-to-work first year post-injury. Secondary outcomes were post-concussion symptoms, disability, the patient's impressions of change and psychological distress. *Results*: Days to sustainable return-to-work was 90 in the intervention and 71 in the control group ($p = 0.375$). The number of post-concussion symptoms were fewer in the intervention (6) compared to the control group (8) at 12 months ($p = 0.041$). No group differences were observed for disability ($p = 0.193$), patients impression of change ($p = 0.285$) or psychological distress ($p = 0.716$). *Conclusion*: The multidisciplinary outpatient follow-up programme focusing on better understanding and reassurance of favourable outcome for mild traumatic brain injury did not improve return-to-work, but may have reduced the development of post-concussion symptoms. Additional studies should focus on which factors exhibit a direct impact on return-to-work.

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Mild traumatic brain injury; post-concussion symptoms; randomised controlled trial; return-to-work; vocational rehabilitation

Introduction

The majority of patients exposed to head trauma sustain a mild traumatic brain injury (MTBI) [1]. The incidence of hospital-treated patients with MTBI is approximately 100–300 patients per 100 000 people, and the actual population-based rate is likely more than 600 patients per 100 000 people [1]. Earlier studies reported that the majority of patients suffering MTBI generally recover within twelve months [2]. Approximately 5–20% of patients with MTBI experience persistent problems, and persistent post-concussion symptoms (PCS) more often occur in those with more acute symptoms and with emotional stress after MTBI [2,3]. For most patients, follow-up care after MTBI is conducted by a general practitioner (GP) [4]. Multidisciplinary treatment programmes or standardised follow-up care are less common. Because a substantial group of patients report symptoms and disability after MTBI, several authors have suggested a need for a more comprehensive follow-up [5–7]. Multidisciplinary treatment is stated to be the best approach for addressing multiple impairments and is recommended in complex cases such as vocational rehabilitation after a brain injury [8–11].

The impact of an early intervention has been debated because of conflicting results and methodological challenges in published studies [4].

Wade and colleagues found that an early intervention offered by a specialist service within 10 days after injury focused on providing information, advice, and support significantly reduced social morbidity and the severity of PCS [12]. A recent review concluded that there is some evidence supporting the efficacy of early reassurance and information after MTBI [4]. However, another systematic review found no effect of early interventions focusing on advisement and reassurance after MTBI [13]. Matuseviciene et al. tried to avoid this confound by offering an early intervention visit by a rehabilitation specialist compared to providing written information to estimated high-risk patients with three or more PCS after MTBI, but their studies showed no difference in return-to-work (RTW) between interventions [14]. RTW is an important goal in rehabilitation because being unemployed affects various dimensions of physical, psychological and social health [15]. RTW has been stated to be a good indicator of patient well-being and adaption after MTBI [16]. According to different cohort studies published, the rate of RTW after one year tends to vary from approximately 55–97%, and a systematic review has concluded that the majority of workers seem to RTW within three to six months after MTBI [3,17–19]. Hence, there is still a need for well-designed clinical studies to evaluate the effect of treatments for RTW after MTBI, and it is suggested that further

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treatment focusing on participation should be individualised [3,4,13,14]. According to other authors additional studies should focus on the timing of the interventions, such as patients with sustainable complaints in the first one to three months after injury [20,21].

The aim of this study was to evaluate the efficacy of a multidisciplinary outpatient follow-up programme by comparing the results to a follow-up by a GP among patients who were sick-listed or at-risk to be sick-listed with persistent PCS two months post-MTBI. The primary outcome was RTW, and the secondary outcomes were symptom burden, disability, the patients' impressions of change and psychological distress at 12 months post-MTBI.

Methods

Study design and participants

This study was a randomised controlled study in which the participants were allocated to a multidisciplinary outpatient treatment programme or a follow-up by a GP after a multidisciplinary examination. Adult patients (aged 16–55 years) admitted consecutively to the Department of Neurosurgery for TBI, ICD-10 diagnosed S06.0–S06.9, with sustained symptoms at six to eight weeks post-MTBI, were considered to be eligible for inclusion in the study. To avoid any bias by age, the upper age of participants was set to 55 years since the primary outcome was RTW. MTBI was defined according to Task Force on MTBI as Glasgow Coma Scale (GCS) 13–15 within 30 min or the lowest score during the first 24 h, unconsciousness less than 30 min and post-traumatic amnesia (PTA) less than 24 h [20]. The patients had to be hospitalised for five hours or longer (included in the in-patient statistics) and they were required to complete a written informed consent to be included in the study.

We included patients who either were sick-listed or at-risk to be sick-listed with persistent PCS symptoms two months after the injury. Patients reporting substantial problems at work or with moderate disability at Glasgow Outcome Scale Extended (GOSE) were defined to be at risk to be sick-listed. The patients who presented major psychiatric diseases or other diseases (previous head trauma) that impacted their working skills were unemployed in the last six months, lacked Norwegian language skills or were out of work diagnosed with substance abuse given in the medical records were excluded from the study. The patients were recruited from two university hospitals in Norway from March 2009 to February 2012. After discharge from the Department of Neurosurgery, further assessments were conducted at two outpatient rehabilitation clinics. The patients were recruited from a mixed rural and urban community where the majority of the inhabitants are Norwegian residents (Caucasians).

The patients were offered a visit to a specialist in rehabilitation medicine following a standardised protocol 6–8 weeks after the injury. A structured interview concerning the patient's history before and after the injury, participation in everyday activities and work was conducted before clinical and neurological examinations were performed. Additionally, the patients were evaluated for current level of PCS, psychological complaints, disability and pain using a self-report questionnaire (see "Outcome" section). Patients meeting the inclusion criteria for this study were offered a targeted multidisciplinary examination two months post-MTBI. The team consisted of a specialist in rehabilitation medicine, a neuropsychologist, occupational therapist, social worker and a nurse. Usually, three of the team members performed additional assessments including neuropsychological assessment if needed for clarifying the diagnosis, defining the relationship to the employer or school, and identifying working skills and routines in daily living. Immediately after the multidisciplinary examination, the participants received their feedback from the examination with information concerning the expected favourable outcome and recommendations regarding gradual RTW. Referral to other specialists or therapists was recommended as needed. The participants' GP received a report from the multidisciplinary examination at baseline, and the GPs were responsible for managing the patients' sick-leave certificates.

Before providing appropriate feedback after the multidisciplinary examination, the participants were randomised either to the intervention or to regular care by their GPs.

Intervention

The multidisciplinary outpatient follow-up programme consisted of individual contacts and a psycho-educational group intervention once a week over a consecutive 4-week period. A schedule for RTW and other activities were developed during the first consultation within two weeks after the multidisciplinary examination. Additional follow-ups during the first year were individually tailored to the individual's needs and problems related to RTW and conducted as long as the participants were sick-listed. Concerns about RTW, employers and benefits were taken care of either by a social worker, occupational therapist or a nurse. The team led by a specialist in rehabilitation medicine evaluated the patient's capabilities and job demands and made a plan for gradually RTW or alternative activities. The occupational therapist helped the patients with memory aids and structuring the day. Psychological distress or cognitive difficulties were followed-up by a neuropsychologist. Principles of cognitive behavioural treatment were used if appropriate. The physician took care of medical problems such as exacerbations. The GP received a report from each follow-up. For only a few patients, we organised meetings with Norwegian Labour and Welfare Service (NAV) or the employer to facilitate the patients' RTW. The group sessions started approximately between nine to sixteen weeks post-injury. The group interventions consisted of receiving education and addressing common problems in daily life after MTBI. The group members shared their experiences and problems after the injury, and they discussed different strategies for lessening the impact and facilitating the process of RTW. They addressed topics related to RTW and reasons for being physically active as a strategy for coping with the difficulties after brain injury.

Control group

The control group was followed-up by a GP after the multidisciplinary examination and was offered their typical, regular

treatment, which so far is not standardised. The recommendation from the multidisciplinary examination gave some directions for further treatment in the control group. The GP could refer to specialists, physiotherapists or other healthcare providers when needed.

Measures

From the self-report questionnaire assessed at the screening consultation 6–8 weeks post-MTBI, we obtained information regarding the cause of injury and the demographic data. From the medical records obtained during the patient's emergency stay, we received information concerning unconsciousness, alcohol intoxication and length of hospital stay. Presence of pathology was based on information from the acute CT scan and the medical records. The GCS scores, ranging from 3 to 15, assess the level of consciousness based on eye, verbal and motor responses [22].

PTA was measured using a standardised interview at the time of the first visit six to eight weeks post-MTBI, asking the patients to retrospectively recall events. PTA was dichotomised into more or less than one hour [23].

To document treatment received by other healthcare providers in each group, the participants received a questionnaire by mail at 6 and 12 months post-MTBI. Numbers of visits the last six months for different types of treatment was categorised from no visits to more than six visits.

Outcomes

The primary outcome measure is days to sustainable RTW up to 12 months after injury, a valid measure to compare RTW in a RCT [24]. The number of days to sustainable RTW was defined as not receiving sick-leave benefits from the NAV for a period of five weeks post-injury. Because a vacation period can last up to five weeks in Norway, we used a period of five weeks to define sustainable RTW. The participants who received no sick-leave benefits were defined as RTW. A sick-listed day was counted if the person was either partly or completely sick-listed. Based on the register data, it was difficult to determine if the sick leave was a result of the MTBI; therefore, all of the sick leaves were recorded.

Secondary outcomes were PCS, disability and the patient's impressions of change.

The Rivermead Post-Concussion Symptoms Questionnaire (RPQ) [25] is a specific 16-item questionnaire that measures cognitive, emotional and physical symptoms. The patients' symptoms during the last 24 h are compared to before the traumatic brain injury, rating the responses of each item using a 5-point Likert scale as follows: 0 = not experienced at all; 1 = no more of a problem; 2 = a mild problem; 3 = a moderate problem; and 4 = a severe problem. The total number of symptoms rated above 1 are counted and summed as recommended by King et al. [25]. RPQ is documented to have high reliability for PCS, but lacking good validity [26]. Several authors recommend therefore using numbers of PCS instead of sum score as recommended by King et al. We therefore present both scores as a secondary outcome [26].

GOSE [27] is an 8-point ordinal global scale that assesses functioning within the areas of independence, work, social and leisure activities and participation in social life. The scales are divided into upper (8) and lower (7) levels of good recovery, upper (6) and lower (5) moderate disability, severe disability (3 and 4), as well as vegetative state (2) and dead (1).

Patient's Global Impression of Change (PGIC) [28] is a 7-point categorical scale where the participants evaluate their overall change from the commencement of the study. Lower scores represent an improvement, very much improved (1), much improved (2), minimally improved (3), no change (4), minimally worse (5), much worse (6) and very much worse (7).

Hospital Anxiety and Depression Scale (HAD) [29] is a self-reported 14-item scale and a measure of anxiety and depression. The participants rate each item using a 4-point scale from no distress (0) to too much distress (3). Each subscale of anxiety and depression ranges from 0 to 21. A total score of 19 or higher using HAD was set as a cut-off for a mental disorder. For each subscale, 11 was set as a cut-off for anxiety and depression [30].

Sample size

The present power calculations were based on the variance in RTW in a previous study [31]. With 15% differences in RTW between the groups, a significance level of 5% and a power of 90%, 184 patients were required in each group.

Randomisation

For each hospital, the participants were randomised into two groups by simple randomisation with 1:1 allocation ratio according to a computer-generated list of random number assignment generated by an independent researcher. The allocation sequence was concealed from the multidisciplinary team, a person who did not participate in the study stored the lists and envelopes with group allocations from the lists were made. Approximately two months post-injury, before the participants received feedback from the multidisciplinary examination, the envelopes containing a card that informed the participants if they were recruited to the intervention group or to the control group were opened.

Blinding

The baseline data were collected before randomisation. The participants and the multidisciplinary team in the intervention group were aware of the allocated arm during the feedback from the multidisciplinary examination two months post-MTBI. The data collection at 12 months was conducted by postal self-report questionnaires, and for GOSE, an assistant who was blinded to the group allocation performed a telephone interview. Two independent persons, who were blinded for the groups and were unfamiliar with the aim and content of the study, entered the data into the SPSS database.

We obtained data concerning sick leave and other sickness benefits from one year before until one year after the injury from the NAV through a third accredited agency, Statistics Norway (SSB), which blinded the data before returning them to the first author.

A statistician, who did not participate in the treatment programme and was blinded to the group allocation when the data were analysed, controlled the data and performed the statistical analyses for RTW and the secondary outcomes.

Statistical method

The statistical analyses were performed using IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY, IBM Corp.

For comparing the outcome data at the 12-month follow-up, we used the chi-squared test for categorical variables and Mann–Whitney *U* test for ordinal variables.

We used a survival analysis to compare days to sustainable RTW in the two groups by landmarking at randomisation time (i.e. sick-listed patients at 60 days after injury are included) [32]. The participants with 366 days of sick leave after injury were censored. Finally, we used the Kaplan–Meier analysis with Log-rank test, and estimated a backward stepwise Cox regression for the intervention to adjust for effect modifiers leading to the final model. To determine the effect modifiers, we estimated the crude model including only intervention as a predictor as well as single-adjusted models including intervention and one adjustment variable at a time using a pre-selected list of variables. Those who significantly changed the hazard ratio of the intervention in the single-adjusted models were included in the stepwise regression. The significance level was set at 0.05.

All the patients who were randomised were analysed, including the participants who did not keep their appointments and did not receive the intervention in the intervention group.

Ethics

The study protocol is registered in Government Clinical trial registry, Identifier NCT00869154, and was approved by The National Committees for Research Ethics in Norway and Norwegian Social Science Data Services.

Results

The participant flow is shown in Figure 1. Almost 261 (30%) of eligible patients did not attend the planned follow-up, contributing to fewer patients recruited than planned. For sustainable RTW, the data were missing from NAV for 1 (1%) participant in the intervention group and were complete in the control group. In the self-report questionnaire, RPQ, 126 (83%) participants had answered their follow-up questionnaires at 12 months (i.e. 70 (86%) participants in the

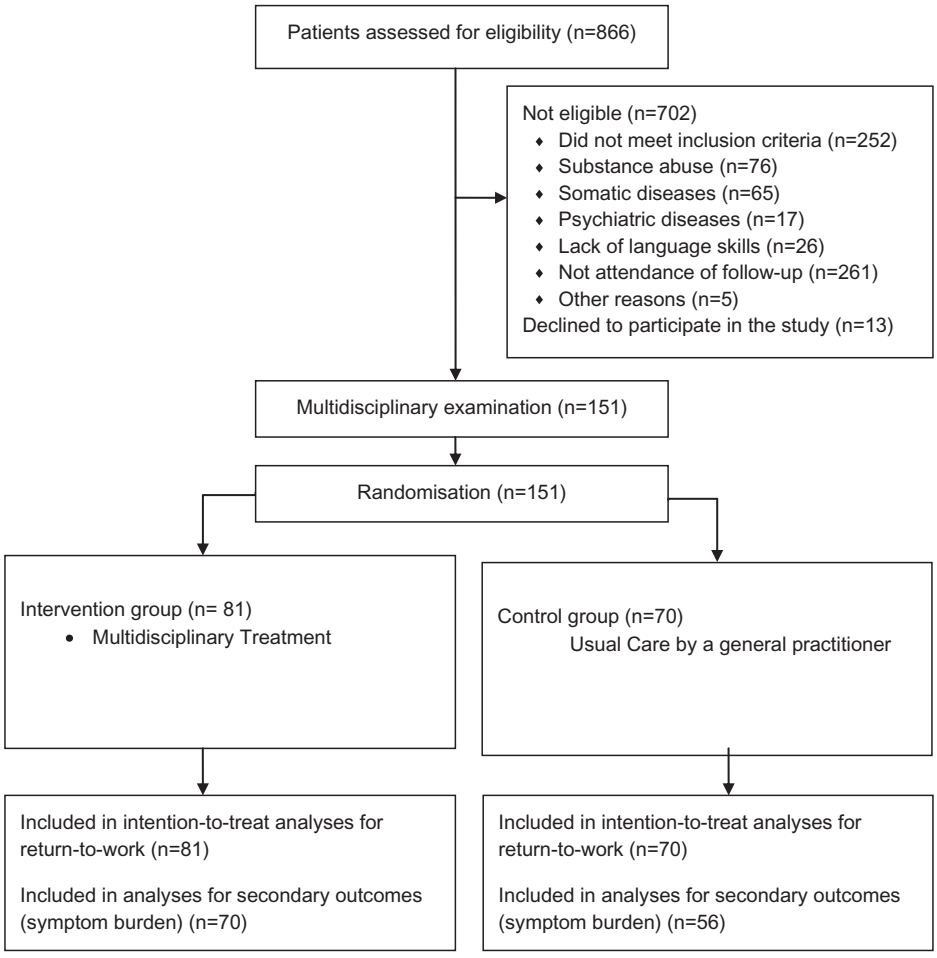

Figure 1. Flow diagram.

intervention group and 56 (80%) participants in the control group).

As shown in Table I, there were no significant differences between the two groups at baseline two months after the injury. In sum, 34 (24%) of 143 participants fulfilled the criteria for a mental disorder, achieving a total score of 19 or higher using HAD or sub-scores of 11 or higher for anxiety or depression. Among these 34 participants, 27 (19%) participants fulfilled the criteria for anxiety, and 18 (13%) participants fulfilled the criteria for depression at baseline using HAD.

The individual follow-ups varied from 0 to 20 with a median of two clinical follow-ups in the first year. A few participants received individual counselling instead of a group intervention. Of the 17 participants who attended fewer than two individual follow-ups or group sessions, 15 of them had RTW at 12 months. Treatment received in the intervention group is shown in Table II.

There was no significant difference between the groups according to the primary outcome measured as days to sustainable RTW after injury to 12 months follow-up. There were no significant differences for the additional characteristics for RTW given in Table III. For the secondary outcome RPQ, there was a significant difference in the numbers of PCS between the groups. The median numbers of PCS were six in the intervention group compared to eight in the control group (p = .041) at 12 months. By using the sum score for RPQ there was not a significant difference between the groups as given in Table IV (p = .096). As shown in Table III there were no significant differences between the groups for the other secondary outcomes PGIC, HAD and GOSE.

Because 45% of the participants were not receiving any benefits from NAV at two months post-MTBI, we performed an additional analysis for days to sustainable RTW from the time of randomisation to 12 months after injury for those who still were sick-listed according to the sick-leave register. In the unadjusted survival analysis, there was no difference between the groups for days to sustainable RTW (Log-rank, Mantel–Cox; p = 0.217). In the final Cox regression model, HAD, RPQ and PTSS were included in the stepwise model. Finally, HAD and RPQ remained as effect modifier variables. As shown in Table IV, the hazard ratio of the intervention 0.48 (0.25, 0.91) was significantly different from 1 (p = 0.025).

As observed in Figure 2, the median sustainable RTW is larger than 366 days after injury in the intervention group and 338 days after injury in the control group for patients who were not sustainable RTW at randomisation.

Even if not significant, we noted that there was a tendency of less use of other healthcare services in the intervention group. As many as 51% of the patients reported no additional treatment in the intervention compared to 36% in the control group (p = 0.199) the first six months, and from 6 to 12 months post-injury it was 52% compared to 38% in the control group that reported no additional treatment (p = 0.135). In the first six months 67% of the patients in the intervention group did not visit their GP compared to 47% in the control group (p = 0.063), and from 6 to 12 months post-injury it was 68% compared to 51% in the control group that reported no visits to the GP (p = 0.089). In the intervention group 10% reported more than six visits by a physiotherapist the first six months post-injury, compared to 23% in the control group (p = 0.107). From 6 to 12 months it was 12% in the intervention and 21% in the control group that reported more than six visits by a physiotherapist (p = 0.219), see Supplemental Table I.

Discussion

In the present study, there were no differences in sustainable RTW at 12 months post-injury between the intervention and control groups. The number of PCS was significantly reduced in the intervention group compared to the control group. However, a difference in days to sustainable RTW was demonstrated in favour of the control group when controlling for the HAD and RPQ scores in an adjusted subgroup analysis of 78 participants who demonstrated unsustainable RTW at the time of randomisation. In our crude model, sick leave before injury did not change the hazard ratio of the intervention and therefore cannot explain the difference in RTW from the subgroup analyses. Several studies have shown that people with more acute symptoms and psychological distress exhibit poorer outcome after MTBI [2]. HAD and RPQ changed the hazard ratio of the intervention, and those effect modifiers reduced sustainable RTW in the control group, producing a significant difference in favour of the control group in the adjusted subgroup analysis.

The majority of participants in the intervention group were sick-listed while they were participating in the four group sessions. By defining sustainable RTW as no sick leave for a period of five weeks, sustainable RTW was delayed for several participants in the intervention group until they had finished their participation in the group sessions. This could explain the potential delay in RTW in the intervention group. The Norwegian welfare model, which compensates 100% of income, and regulations concerning job security may also delay RTW, especially among patients in a follow-up programme that justifies being sick-listed [33].

It is questionable whether excessive attention to symptoms and reduced focus on aspects concerning RTW could have produced a negative impact on the outcome of RTW in the intervention group. By excessively focusing on difficulties in daily life as a consequence of symptoms and cognitive impairment after MTBI, the intervention could have had a negative impact on the belief in RTW [34]. Vocational rehabilitation is a challenge because work disability is multifactorial and can be due to problems at the individual, environmental and social levels [3]. In our approach, we used an individually tailored model for RTW; however, regular work visits to employers were not performed. Several authors have suggested that a structured RTW protocol that includes work visits might be beneficial in determining the gap between the patients' capabilities and their work requirements [35,36]. By conducting early standardised visits to the workplace to optimise RTW and by focusing on a gradual exposure to activities upon RTW, as recommended by Radford et al., we assume that RTW would improve [37]. Finally, it is recommended that early vocational rehabilitation be integrated into the early rehabilitation process [35,38].

Table I. Demographic, clinical and injury-related characteristics at baseline (n = 151).

	All		Intervention group (n = 81)		Control group (n = 70)	
Variable	Total	n (%)	Total	n (%)	Total	n (%)
Demographics						
Age, years[1]	151	32 [16,55]	81	31 [16,55]	70	35 [16,55]
Sex, men	151	92 (61%)	81	49 (61%)	70	43 (61%)
Relationship status	151		81		70	
Single		42 (28%)		25 (31%)		17 (24%)
Living with parents		26 (17%)		15 (19%)		11 (16%)
Married/cohabiting		74 (49%)		38 (47%)		36 (51%)
Divorced		9 (6%)		3 (4%)		6 (9%)
Education (self-report)	150		81		69	
Higher education >13 year		64 (43%)		36 (44%)		28 (41%)
Employment status	150		81		69	
Full-time		115 (77%)		60 (74%)		55 (80%)
Part-time		6 (4%)		5 (6%)		1 (1%)
Unemployed		5 (3%)		4 (5%)		1 (1%)
Student		24 (16%)		12 (15%)		12 (17%)
Days sick-listed last year before injury[1]		0 [0,366]	80	1 [0,366]	70	0 [0,365]
Cause of injury	151		81		70	
Traffic accident		44 (29%)		23 (28%)		21 (30%)
Fall		56 (37%)		30 (37%)		26 (37%)
Assault		27 (18%)		16 (20%)		11 (16%)
Sports injury and others		24 (16%)		12 (15%)		12 (17%)
Clinical characteristics						
Glasgow Coma Scale (GCS)[2]	151	15 [13,15]	81	15 [13,15]	70	15 13,15]
GCS 13		8 (5%)		6 (7%)		2 (3%)
GCS 14		31 (21%)		15 (19%)		16 (23%)
GCS 15		112 (74%)		60 (74%)		52 (74%)
PTA > 1 h	142	39 (28%)	79	23 (29%)	63	16 (25%)
Consumed alcohol	112	43 (38%)	59	25 (42%)	53	18 (34%)
Hospital length of stay[1]	150	1 [1,9]	80	2 [1,16]	70	1 [1,9]
Radiological examination[2]						
CT examination	151	145 (96%)	81	79 (98%)	70	66 (94%)
Intracranial injury	151	41 (27%)	81	23 (28%)	70	18 (26%)
Skull fracture	151	22 (15%)	81	10 (12%)	70	12 (17%)
The Rivermead Post Concussion Symptoms Questionnaire						
Total score (0–64)[1]	150	22 [0,56]	80	20 [0,54]	70	24 [0,56]
Cognitive (0–12)[1]	150	6 [0,12]	80	5 [0,12]	70	6,5 [0,12]
Emotional (0–16)[1]	150	4 [0,16]	80	4 [0,16]	70	5 [0,14]
Somatic (0–36)[1]	150	12 [0,30]	80	10 [0,28]	70	13 [0,30]
Number of symptoms (0–16)[1]	150	8 [0,16]	80	8 [0,15]	70	9 [0,16]
The Hospital Anxiety and Depression Scale (HAD)						
Total score (0–42)[1]	143	10 [0,30]	75	11 [0,30]	68	10 [0,29]
HAD anxiety (0–21)[1]	143	7 [0,19]	75	7 [0,19]	68	7 [0,16]
HAD depression (0–21)[1]	143	4 [0,14]	75	4 [0,14]	68	4 [0,14]
Glasgow Outcome Scale—Extended (GOSE, 1–8)	149	6 [4,8]	79	6 [4,8]	70	6 [5,8]

[1]Median [min, max]
[2]Measured at time of injury

We found a significant reduction in the number of PCS in the intervention group. In the literature, there is no definition of a clinically relevant result for a reduction in PCS. Some authors have stated that a 15% reduction in the PCS score is a clinically relevant result, but this outcome measure remains to be sufficiently validated [39]. From a clinical perspective, we consider a reduction from 8 to 6 PCS as relevant because it reduces the total symptom burden on patients. The RPQ could also be expressed as a sum score. For this measure, our analysis showed no significant difference between the groups (p = .096). This result indicated that the sum RPQ score and the number of symptoms measure different features. Notably, the effect of the intervention on RPQ was weak and lacked significance when adjusted for multiple comparisons. Finally, we cannot exclude the possibility that patients who RTW despite persistent symptoms developed more PCS.

There was no significant difference between the groups for the secondary outcomes HAD, GOSE and PGIC. By screening for psychological distress and by recommending a referral to a psychologist or a psychiatrist after the multidisciplinary examination at two months post-injury, both groups may have been offered treatment for their treatable co-morbidities and psychological distress to the same extent [4,6].

Similar to other authors, we found a tendency for less frequent healthcare use among patients receiving multidisciplinary treatment [37,40]. This finding could be by chance, but the use of other healthcare services by patients receiving multidisciplinary treatment must be investigated in other studies.

Early interventions or follow-ups have not improved outcome, most likely as a consequence of recruiting patients who might have recovered within a few weeks regardless of treatment [21,41–43]. Matuseviciene et al. offered an early intervention visit to a select group of patients with three PCS at ten days post-injury, but this intervention showed no effect on RTW compared to the control [14]. In that study, 97 of 174 (56%) patients admitted to the hospital with PTA < 1 h were recruited, compared to 151 of 702 (22%) hospitalised patients with PTA < 24 h in our study [14]. Wade et al. improved the outcome of their early multidisciplinary

Table II. Description of intervention (n = 151).

Time after injury		Intervention group (n = 81) Total	Intervention group (n = 81) Number of visits	Control group (n = 70) Total	Control group (n = 70) Number of visits
6–8 weeks	Visit by a specialist in rehabilitation medicine	81	1	70	1
8–9 weeks	Multidisciplinary examination	81	1	70	1
	Clinical assessments and diagnostic evaluation				
	Clarify working situation and goals of the patients				
	Investigate the capabilities of the patients and job demands				
	Randomisation	81	1	81	1
	Feedback from the multidisciplinary examination to the participants	81	1	81	1
	Information about favourable outcome				
	Re-establishing structured routines in daily living				
	Stepwise return-to-work (RTW) and other activities				
	Finding acceptable strategies to lessen the impact (memory aids)				
	Recommendation about referral to other specialists or therapists				
	Multidisciplinary outpatient follow-up programme				
9–20 weeks	Psycho-educational group intervention	81	3 [0,4][2]		–
	Programme, two hours in four consecutive weeks				
	Education about mild traumatic brain injury (MTBI)				
	Addressing common problem after MTBI				
	Facilitating the process of RTW				
	Sharing experiences and problems after MTBI				
	Discussing different strategies for coping				
	Physical active as a strategy for coping with the difficulties				
	Multi-tasking and relaxation exercises				
9–52 weeks	Individually follow-ups	81	2 [0,20][2]		–
	Plan for gradually RTW and other activities				
	Evaluation of capabilities and RTW				
	Participation in two or more group interventions	81	52 (64%)[1]		–
	No participation in a group intervention	81	24 (30%)[1]		–
	Neither participation in group or additional clinical follow-ups	81	6 (7%)[1]		–
	Meeting with the employer or school to facilitate RTW	81	5 (6%)[1]		–
	Telephone to employer or school to facilitate RTW	81	6 (7%)[1]		–
	Meeting with the Norwegian Labour and Welfare Service (concerns about sick-leaves benefits and pre-work training)	81	6 (7%)[1]		–
	Telephone to the Norwegian Labour and Welfare Service	81	5 (6%)[1]		–

[1]n (%)
[2]Median [min, max]

intervention. In their study, the participants had more severe symptoms, as 60% of the patients exhibited PTA > 1 h, compared to 28% of the patients in our study [12]. Both the severity of injury and the timing of intervention, which avoided including those patients who had recovered within two months, may explain why we found a positive trend concerning PCS for our intervention. In our study, both groups received a multidisciplinary examination with feedback and reassurance, indicating similarities in the baseline treatment offered between the two groups. Most patients terminated the follow-up programme as a result of their RTW, and for patients who remained sick-listed, there was a difference in the amount and content of treatment. Our results indicate that a multidisciplinary approach may have had a positive impact on the number of PCS in a vulnerable group of patients who required additional support.

Strengths and limitations

One limitation of this model was that a GP managed the sick-leave certificates for the intervention group. After a clinical follow-up, in the intervention group, the GP received a report with a recommendation for further sick-leave certification and other information concerning RTW. We were therefore dependent on the GP to follow our recommendations in the report.

The present study included patients who were admitted to a hospital with MTBI and were sick-listed or were at risk to be sick-listed with persistent PCS two months after the injury. Because this intervention study aimed to focus on this subgroup of admitted patients, we completed the study with fewer patients than we had estimated. It was not realistic to prolong the inclusion period for more than three years, and our study was unfortunately inadequately powered for the number of patients recruited in the RCT and the primary outcome of RTW. It appears that recruiting an adequate number of patients to achieve statistical power is a common problem in this type of study [13,14]. If we had succeeded in recruiting a significantly higher number of patients to the study, we could have achieved a more consistent difference between the groups. However, if we need to treat too many patients to find a favourable outcome in one intervention, the intervention probably has no clinical importance. Compared to other studies, our study was adequately powered for evaluation of the secondary outcomes [44]. One strength of our study was that we used sick-leave data from a national register, avoiding high rates of missing outcome data that could bias the results [20,45]. However, the data regarding sick leave from a national register have also limitations. We do not know whether the sick leave is a result of the MTBI or whether it is caused by other disorders. Therefore, we defined all participants who were sick-listed independent of diagnosis in this study as not RTW after the MTBI [46]. However, there

Table III. Return-to-work and clinical outcomes 12 months after mild traumatic brain injury.

	All		Intervention group		Control group		
	(*n* = 151)		(*n* = 81)		(*n* = 70)		
Sick leave	Total	*n* (%)	Total	*n* (%)	Total	*n* (%)	*p*-value
Primary outcomes							
Days to sustainable RTW[1] first year after injury							
All patients[2,3]	150	81 [0,366]	81	90 [0,366]	69	71 [0,366]	
Not sustainable RTW at randomisation[3]	83	364[66,366]	46	–[68,366][4]	37	346 [66,366]	0.217[5]
RTW at 12 months after injury	151	99 (66%)	81	49 (60%)	70	50 (71%)	0.173[6]
Days sick-listed first year after injury[3]	150	132 [0,366]	81	121 [0,366]	69	134 [0,366]	0.617[7]
Secondary outcomes							
RPQ[8] total score (0–64)[3]	126	17 [0,50]	70	14 [0,48]	56	21,5 [0,50]	0.096[7]
RPQ number of symptoms (0–16)[3]		7 [0,16]		6 [0,16]		8 [0,16]	0.041*[7]
Glasgow Outcome Scale—Extended (1–8)[3]	125	7 [5,8]	69	7 [5,8]	56	7 [5,8]	0.193[7]
Patient Global Impression of Change (1–7)[3]	120	2 [1,6]	67	2 [1,5]	53	2 [1,6]	0.285[7]
Improvement reported on PGIC	120	102 (85%)	67	58 (87%)	53	44 (83%)	0.615[6]
HAD[9] total score (0–42)[3]	124	9 [0,32]	68	8 [0,32]	56	9,5 [0,30]	0.716[7]
HAD anxiety (0–21)[3]	124	6 [0,18]	68	6 [0,18]	56	6 [0,16]	0.860[7]
HAD depression (0–21)[3]	124	3 [0,16]	68	3 [0,16]	56	3,5 [0,14]	0.746[7]

[1]Return-to-work
[2]Including patients sustainable RTW before randomisation
[3]Median [min, max]
[4]Less than 50% RTW
[5]Logrank Test
[6]Chi-square Test
[7]Mann-Whitney U Test
[8]The Rivermead Post concussion Symptoms Questionnaire
[9]The Hospital Anxiety and Depression Scale
*Significance: $p < 0.05$.

Table IV. Cox Regression analysis for sustainable return-to-work until 12 months after mild traumatic brain injury for intervention as a predictor and one adjustment variable at time.

	HR Intervention	
Adjustment	HR (CI)	*P*-value
Unadjusted model	0,68 (0.37,1.25)	0.220
Final Model[1]	**0,48 (0.25,0.91)**	**0.025**
Age	0,71 (0.38,1.32)	0.284
Sex	0,68 (0.37,1.25)	0.214
Post-concussion symptoms (RPQ numbers)	***0,50 (0.27,0.94)***	***0.030***
Post-traumatic stress (PTSS-10)	***0,57 (0.31,1.06)***	***0.074***
Anxiety and depression (HADS)	***0,55 (0.30,1.03)***	***0.064***
Expectation of favourable outcome	0,66 (0.36,1.22)	0.187
Subjective health complaints (SHC)	0,60 (0.32,1.11)	0.103
Widespread pain (pain drawing)	0,81 (0.44,1.50)	0.501
Headache (NRS)	0,65 (0.36,1.20)	0.172
Neck pain (NRS)	0,76 (0.41,1.39)	0.368
Low back pain (NRS)	0,86 (0.46,1.58)	0.621
Glasgow Outcome Scale Extended (GOSE)	0,62 (0.33,1.15)	0.129
Severe and Moderate disability (GOSE < 6)		
Moderate disability (GOSE = 6)		
Good recovery (GOSE > 6)		
Intracranial injury (CT-scan)	0,69 (0.38,1.27)	0.238
Sick-listed last year	0,78 (0.42,1.44)	0.426
Sick-listed at 2 months (baseline)	1,00 (0.54,1.84)	1.000

[1]Adjusted for RPQ and HADS

Adjustment variables used in the stepwise model are marked italic bold.

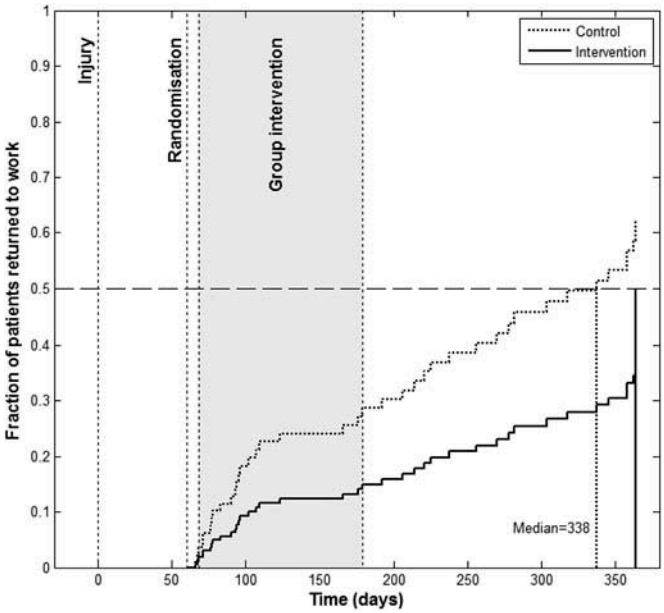

Figure 2. Sustainable return-to-work after mild traumatic brain injury.

was a significant difference in days sick-listed between one year before and one year after the injury, with a median of 0 days before and 132 days after the injury. This result indicates that the sick leave was associated with the MTBI. The national register contains only information from sick-leave certificates completed by a physician. In the Norwegian system, physicians do not report short-term sick leave, leading to underestimation in the registry. Participants who were students or were unemployed must be disabled for one year before they can receive any benefits from the NAV. Therefore, we reasoned that the participants were sick-listed in the 12 months preceding MTBI if they were receiving a benefit from the NAV. We most likely missed information regarding sick leave if the participants were students and were sick-listed for less than one year. The participants who were students were included in all of the analyses performed in this study because the primary analysis was aimed at intention-to-treat. From the register, we unfortunately did not obtain

information about whether the participants were part-time or full-time sick-listed. Such information would have increased the accuracy of the analysis.

For the secondary outcome measures, from 79% to 83% of the participants completed the follow-up questionnaires, and this response rate strengthens the subjective measures. One limitation of the present study was that the participants and the therapists were not blinded to the treatment. Difficulty in blinding the patients and the therapists to treatment in complex rehabilitation studies is a common problem [47].

Conclusions

In conclusion, our multidisciplinary outpatient follow-up programme did not improve RTW in a vulnerable group of patients but may have reduced the development of PCS. Future research should consider all known prognostic factors for RTW when designing an intervention protocol focused on RTW, including early standardised work visits for those who need this form of care.

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Declaration of Interest

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Supplemental Materials

Supplemental data can be accessed on the publisher's website.

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