

ORIGINAL REPORT

MILD TRAUMATIC BRAIN INJURIES: A 10-YEAR FOLLOW-UP

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**Objective and design:** Long-term consequences of mild traumatic brain injuries were investigated based on a 10-year follow-up of patients from a previously-published randomized controlled study of mild traumatic brain injuries. One aim was to describe changes over time after mild traumatic brain injuries in terms of the extent of persisting post-concussion symptoms, life satisfaction, perceived health, activities of daily living, changes in life roles and sick leave. Another aim was to identify differences between the intervention and control groups.

**Patients:** The intervention group comprised 142 persons and the control group 56 persons.

**Methods:** Postal questionnaires with a response rate of 56%.

**Results:** No differences over time were found for the intervention and control groups in terms of post-concussion symptoms. In the intervention group some variables in life satisfaction, perceived health and daily life were decreased. Some roles had changed over the years for both groups. No other differences between the intervention and control groups were found. However, in both groups sick leave decreased.

**Conclusion:** Early individual intervention by a qualified rehabilitation team does not appear to impact on the long-term outcome for persons with symptoms related to mild traumatic brain injuries. The status after approximately 3 weeks is indicative of the status after 10 years.

**Key words:** brain concussion; brain injuries; traumatic; post-concussion symptoms; quality of life; rehabilitation; intervention studies; RCT.

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INTRODUCTION

Mild traumatic brain injuries (MTBI), defined as; “any period of loss of consciousness; any loss of memory for events immediately before or after the accident; any alteration in mental state at the time of the accident (e.g. feeling dazed, disoriented, or confused); loss of consciousness of approximately

30 minutes or less; after 30 minutes, an initial Glasgow Coma Scale of 13–15; and post-traumatic amnesia not greater than 24 hours” (1), has an incidence in Sweden of approximately 175 per 100,000 inhabitants per annum (2).

MTBI can be followed by post-concussion symptoms (PCS), such as headaches, memory problems, dizziness, irritability and poor concentration (3). An important symptom is fatigue, which influences mental health and, in turn, participation in social, leisure and work activities. Over time, the problems with fatigue will, however, diminish, but some persons will experience problems even after 10 years (4) and so will continue to require healthcare services (5). Many persons who have MTBI have a decreased health-related quality of life (6, 7). However, previous studies have demonstrated that insufficient attention has been paid to the role of psychological distress or pain from associated injuries contributing to PCS (8).

Pre-existing psychiatric or substance abuse problems, poor general health, depression, life stress, unemployment, and protracted litigation may hinder patient recovery (9).

In a prospective randomized controlled trial (RCT) comprising 355 MTBI patients over the years 1997–2001 (see Fig. 1), no improvements were found at the 1-year follow-up in the 96 persons who received intervention, nor in the 150 persons who declined intervention (10). The 96 persons in the intervention group received intervention comprised of information provision, counselling, general encouragement and pharmaceutical assessment 2–8 weeks after the injury. Furthermore, individualized treatment was provided to address PCS and enhance daily activities. Controls ( $n=109$ ) and persons in the intervention ( $n=150$ ) group who declined intervention recovered and returned to their pre-injury status. Hence, individual intervention by a qualified rehabilitation team did not appear to change the outcomes 1 year after injury.

At present, i.e. 10 years later, no follow-up exists within the public medical service in Sweden for persons with MTBI (11), and the evidence remains limited about how best to support them (12, 13). Hence, however unlikely, possible long-term effects of the individual interventions remain unclear. Consequently, the aim of the present study was to investigate the long-term consequences of MTBI, based on a 10-year follow-up of patients from a previously-published randomized controlled study of mild traumatic brain injuries (10). The objective was to describe changes that occur in the 10 years

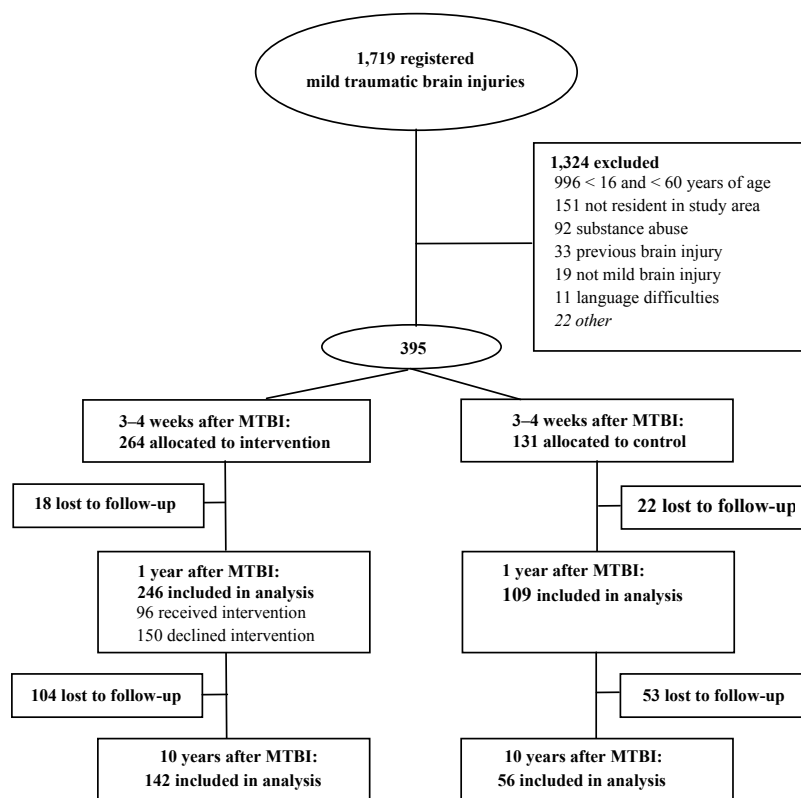


Fig. 1. Trial flow-chart. MTBI: mild traumatic brain injury

following MTBI, in terms of residual PCS, life satisfaction, participation in activities of daily living (ADL), perceived health, changes of life roles and sick leave. A secondary objective was to examine any differences between the group that received intervention and the control group, approximately 10 years after MTBI.

## METHODS

### Participants

Fig. 1 shows the patients' flow through the trials. Approximately 10 years after the MTBI, the 355 persons who participated in the original RCT (10) were posted the same questionnaire again. The inclusion criteria for the original study were: age range 16–60 years with MTBI according to the definition of a Mild Traumatic Brain Injury by the American Congress of Rehabilitation Medicine (Mild Traumatic Brain Injury Committee 1993) (1).

Exclusion criteria for the original study described above were: previous clinically significant brain disorders (earlier brain injury, psychiatric disease, or intellectual disabilities), a history of substance abuse, language difficulties (non-native Swedish speakers) and not being a resident of the catchment area.

Randomization was performed in the proportion 2:1 (rehabilitation group: control group) (14). The two groups were balanced according to the following 10 variables (age, sex, loss of consciousness, amnesia, acute alcohol intoxication, focal neurology, dizziness, headache, vomiting, and nausea). In the intervention group, 246 patients were contacted by telephone 2–8 weeks (median 3 weeks) after the MTBI. The patients were asked if anything had changed in their lives after the injury. There were 150 of the 246 patients who just had a few PCS and stated that their health had been restored to pre-injury level and thus declined treatment. The remaining 96 patients who felt unwell because

of PCS were offered an appointment at the rehabilitation centre. The control group had no contact with the rehabilitation centre.

In the present follow-up study total, 142 (58%) persons in the intervention group and 56 persons (51%) in the control group agreed to participate. Their demographic data are presented in Table I.

No drop-out analysis was performed.

### Instruments

The assessments instruments were:

- Post-Concussion Symptoms Questionnaire (PCSQ), comprising 20 "Yes" or "No" questions (3).
- Life Satisfaction Questionnaire (LiSat-11) (15), comprising 11 questions responded to on a 6-grade scale. Higher scores indicate better life satisfaction.

Table I. Demographic data of the participants

	Intervention group (n=142)	Control group (n=56)
Age, years, mean, (median) [range]	43 (40) [26–68]	44 (42) [26–68]
Sex, male/female, n	84/58	37/19
Marital status, n <sup>a</sup>		
Single adult	16	7
Married/cohabiting	113	44
Divorced/widowed/separated	10	5
Employment		
Student	17	5
Employed, n	95	39
Unemployed	2	0
Full-time housework	11	5
Retired	5	2
Sick listed	12	5

<sup>a</sup>Missing data for 3 participants.

- Instrumental Activity Measure (IAM) is a modified version that includes 11 "Yes" or "No" questions within areas that would normally be performed in daily life (16).
- Short-Form Health Survey (SF-36) (17, 18), which quantifies bodily and mental aspects by self-rating 8 health domains, viz. Physical functioning, Role functioning – physical, Bodily pain, General health, Vitality (energy and fatigue), Social functioning, Role functioning – emotional, Mental health. The 8 domains include 36 items. The item raw scores are summed and transformed into a 0–100 scale, where higher scores indicate better health.
- A modified Swedish version (19) of the Role Checklist (20), including 11 "Yes" or "No" questions on "at present" participation in different occupational roles and 11 "Yes" or "No" questions on sought after, i.e. "wish to", participation in these roles.
- Self-reported sick leave data for the last 10 years.

The study was approved by a regional ethics committee at Gothenburg University.

#### Statistical methods

Comparisons within the groups were made between baseline, i.e. the injured person's self-rated measurement on the following instruments: LiSat-11, IAM, Role Checklist, and the 10-year follow-up. PCSQ, SF-36 and sick leave within-group data were compared between 1 and 10 years after the injury. Statistical analyses were performed using the Statistical Package for Social Science (SPSS) (version 14.0). Pearson's  $\chi^2$  or Fischer's exact test, depending on the expected count, were used to analyse changes over time and differences between the two groups with respect to PCSQ, IAM, Role Checklist and sick leave data. Wilcoxon's signed-rank test was used to analyse the paired LiSat-11 and SF-36 data over time and Mann-Whitney *U* test to analyse differences between the two groups with respect to LiSat-11 and SF-36 data at the 10-year follow-up.

All analyses were based on a  $\alpha=0.05$ , but Bonferroni corrections were applied to avoid type I errors. Hence, the critical  $\alpha$ -values were adjusted to:

- 0.0040 for IAM and LiSat-11 item comparisons;
- 0.0020 for PCSQ and Role Checklist item comparisons;
- 0.0014 for SF-36 data item comparisons.

## RESULTS

### Post-concussion symptoms

In the analysis of the persistence of post-concussion symptoms, no differences were found over time, either within the intervention group, or within the control group. Comparisons of data between the intervention group and control group collected at the 10-year follow-up revealed no differences, as shown in Table II.

### Life Satisfaction Questionnaire

With respect to "Life in general", comparisons of data at baseline and 10 years after injury revealed a decrease in life satisfaction for the intervention group, i.e. a mean decrease of 0.32 (95% confidence interval (CI) 0.13–0.53,  $Z(133)=-3.1$ ,  $p=0.002$ ), in "Contacts" with friends and acquaintances, i.e. a mean decrease of 0.45 (95% CI 0.28–0.68,  $Z(133)=-3.6$ ,  $p<0.001$ ), and in the ability to manage ADL, i.e. a mean decrease of 0.35 (95% CI 0.19–0.51,  $Z(131)=-4.1$ ,  $p<0.001$ ). However, the item "Somatic health" decreased in both groups, i.e. the mean decrease in the intervention group was 0.51 (95% CI 0.28–0.74,  $Z(134)=-4.2$ ,  $p<0.001$ ), whereas a mean decrease of 0.80 (95% CI 0.41–1.2,  $Z(53)=-3.7$ ,  $p<0.001$ ) was found in the control group. No other decreases were found over time. Furthermore, between the 2 groups at the 10-year follow-up, no differences were found with respect to any of the items in LiSat-11.

### Instrumental Activity Measure

In the intervention group, more participants reported problems cooking a meal and fewer were driving at the 10-year follow-

Table II. Post-concussion symptoms questionnaire data at 1 and 10 years after mild traumatic brain injuries. Critical  $\alpha$ -value after Bonferroni correction = 0.0020

	Intervention group		Controls		<i>p</i> -values; differences between intervention and control group after 10 years
	1 year after injury Yes/No ( <i>n</i> =226)	10 year after injury Yes/No ( <i>n</i> =134)	1 year after injury Yes/No ( <i>n</i> =101)	10 year after injury Yes/No ( <i>n</i> =55)	
Post-concussion symptoms					
Extremity weakness	50/175	44/88	22/80	13/42	0.175 <sup>a</sup>
Sensitive to noise	55/169	39/94	22/80	11/44	0.146 <sup>a</sup>
Hard of hearing	33/190	35/98	12/89	11/44	0.338 <sup>a</sup>
Sensitivity to light	44/181	28/105	15/87	5/50	0.047 <sup>a</sup>
Visual impairment	59/163	47/86	26/76	17/37	0.575 <sup>a</sup>
Anosmia	15/208	11/121	2/100	1/54	0.114 <sup>b</sup>
Dizziness	69/155	33/101	29/71	9/45	0.185 <sup>a</sup>
Language difficulties	56/167	34/98	16/86	8/47	0.071 <sup>a</sup>
Orientation problems	10/215	5/129	6/96	1/54	0.673 <sup>b</sup>
Decreased simultaneous capacity	37/186	25/108	14/88	6/48	0.494 <sup>a</sup>
Fatigue	89/132	54/79	28/73	16/39	0.125 <sup>a</sup>
Poor concentration	72/151	41/92	25/76	10/45	0.070 <sup>a</sup>
Poor memory	61/161	43/91	22/80	12/43	0.121 <sup>a</sup>
Irritability	79/146	44/90	25/77	13/42	0.195 <sup>a</sup>
Anxiety	64/161	35/95	22/80	12/43	0.441 <sup>a</sup>
Depression	78/144	46/87	30/71	13/42	0.205 <sup>a</sup>
Emotional lability	62/161	49/84	20/81	10/45	0.013 <sup>a</sup>
Sleep disturbances	37/186	37/96	20/82	10/45	0.370 <sup>a</sup>
Increased sleeping times	39/182	19/73	12/90	6/30	0.628 <sup>a</sup>
Headache	92/131	39/94	35/67	13/42	0.402 <sup>a</sup>
Neck pain	77/145	46/88	43/58	17/38	0.643 <sup>a</sup>

<sup>a</sup> $\chi^2$  test, <sup>b</sup>Fisher's exact test.

Table III. Changes in daily activities as measured by Instrumental Activity Measure (IAM) between baseline and at the 10-year follow-up. Critical  $\alpha$ -value after Bonferroni correction = 0.0040

IAM items covering whether daily activities are carried out ("Do you ...?") and encountered problems or difficulties in:	Intervention group			Control group			Differences at 10-year follow-up between the 2 groups	
	Baseline	10-year follow-up	<i>p</i>	Baseline	10-year follow-up	<i>p</i>	<i>p</i>	<i>p</i>
	Yes/No ( <i>n</i> )	Yes/No ( <i>n</i> )		Yes/No ( <i>n</i> )	Yes/No ( <i>n</i> )			
Personal hygiene, grooming, dressing	3/233	4/137	0.432	3/99	3/53	0.667	0.408	
Outdoor mobility	3/233	6/135	0.085	3/99	1/56	1.0	0.676	
Preparing a snack	2/234	2/139	0.632	2/100	0/57	0.537	1.0	
Cooking a meal	3/232	6/135	0.002*	3/99	5/52	0.036	0.301	
Cleaning	10/225	15/126	0.085	6/96	7/50	0.136	0.739	
Do you use public transport?	69/163	25/115	0.011	29/73	9/48	0.073	0.728	
Problems with public transportation	5/199	9/120	0.45	3/87	2/51	1.0	0.514	
Do you drive?	164/71	125/15	<0.001*	70/31	50/6	0.005	1.0	
Problems driving a car	9/213	14/125	0.023	2/89	3/51	0.361	0.406	
Shopping	7/228	15/126	0.016	3/99	7/50	0.226	0.739	
Washing	7/228	9/132	0.113	4/98	5/52	0.284	0.550	

\*Significantly different ( $p < 0.0040$ ) at the 10-year follow-up compared with baseline.

up in comparison with baseline, as shown in Table III. At the 10-year follow-up, no differences were found between the two groups with respect to any of the items in IAM.

#### Short-Form Health Survey

In the analyses of the SF-36 data over time, 2 of the 8 domains, viz. "Bodily pain" and "Vitality (energy and fatigue)" demonstrated a lower score at the 10-year follow-up in the intervention group. For the control group, no differences over time were found. Moreover, no differences were found between the two groups at the 10-year follow-up, as shown in Table IV, which also provides Swedish reference data.

#### Role checklist

More persons in the intervention group aimed to have the "Student" role at baseline rather than after 10 years. The intervention group further claimed to have "Other" roles more frequently at 10 years than at baseline, whereas the control group had the role as "Friend" less frequently at 10 years than at baseline, as shown in Table V. No differences were found between the two groups at the 10-year follow-up.

#### Sick leave data

No significant differences were found between the two groups at the 1-year follow-up and at the 10-year follow-up. However, in both groups, a decrease in sick leave was found. At the 1-year follow-up, 15% were on sick leave, whereas at the 10-year follow-up, 9% were on sick leave. Of those 17 persons', 9 persons' sick leave could be attributed to the MTBI, whereas the others' sick leave had no association with their MTBI.

## DISCUSSION

Based on the 10-year follow-up, early individual intervention by a qualified rehabilitation team does not appear to impact on the outcome for persons with MTBI. This is consistent with findings from the one-year follow-up (10). It is plausible that those with few PCS recovered spontaneously within a period of two weeks up to two months after MTBI, while persons with more PCS and other problems approximately 2–8 weeks after injury did not improve after 1 year, nor after 10 (10) years. All acquired PCS remained stable in both groups, and no new symptoms occurred. Indeed, the persons in the intervention

Table IV. Changes in daily activities as measured by Short-Form Health Survey between 1 year after injury and at the 10-year follow-up. Critical  $\alpha$ -value after Bonferroni correction = 0.0014. Reference data are provided

Items	Intervention group 1 year after injury ( <i>n</i> = 226)	Control group 1 year after injury ( <i>n</i> = 101)	Intervention group 10 year after injury ( <i>n</i> = 140)	Control group 10 year after injury ( <i>n</i> = 56)	Swedish reference group (18) ( <i>n</i> = 8930)
Physical functioning	90.6 (88.3–92.8)	90.6 (87.6–93.6)	85.7 (82.3–89.2)	88.9 (83.5–94.4)	87.9 (87.5–88.3)
Role functioning – physical	77.1 (72.6–81.6)	72.5 (65.3–79.7)	74.5 (68.0–80.9)	75.9 (66.1–85.8)	83.2 (82.5–83.8)
Bodily pain	70.4 (66–74.0)	66.2 (60.1–72.2)	66.5 (61.9–71.1)*	60.6 (52.4–68.4)	74.8 (74.3–75.4)
General health	70.7 (67.4–55.2)	70.1 (65.1–75.1)	68.2 (64.1–72.2)	67.3 (60.1–74.5)	75.8 (75.4–76.3)
Vitality (energy and fatigue)	58.5 (55.2–61.8)	59.8 (55.0–64.5)	55.9 (51.9–59.8)*	56.5 (49.4–65.3)	68.8 (68.3–69.3)
Social functioning	84.1 (81.2–87.1)	81.2 (76.1–86.3)	82.2 (78.1–86.4)	82.7 (75.8–89.7)	88.6 (88.2–89.0)
Role functioning – emotional	76.2 (71.5–81.0)	74.9 (67.4–82.4)	73.8 (67.6–80.1)	82.1 (73.8–90.3)	85.7 (85.0–86.3)
Mental health	73.1 (70.3–75.8)	75.1 (70.8–79.4)	72.7 (69.7–75.8)	77.2 (72.1–82.3)	80.9 (80.5–81.3)

\*Significantly different ( $p < 0.0014$ ) at the 10-year follow-up compared with one year after injury.

Table V. Changes in roles as measured by Swedish Role Checklist between baseline and the 10-year follow-up. Critical  $\alpha$ -value after Bonferroni correction = 0.0020

Roles		Intervention group		<i>p</i>	Control group		<i>p</i>	Differences at 10-year follow-up between the 2 groups
		Baseline Yes/No (n=246)	10-year follow-up Yes/No (n=138)		Baseline Yes/No (n=109)	10-year follow-up Yes/No (n=55)		
Student	At present	32/182	7/127	0.005	19/81	2/48	0.013	1.000
	Wish to	90/103	34/88	0.001*	34/51	10/37	0.029	0.382
Worker	At present	170/47	112/24	0.360	72/29	39/12	0.497	0.364
	Wish to	182/19	107/15	0.420	76/13	41/6	0.768	0.934
Care-giver	At present	88/128	69/67	0.066	42/59	25/26	0.383	0.834
	Wish to	130/68	94/28	0.031	52/36	30/17	0.591	0.081
Home maintainer	At present	193/25	128/10	0.192	84/19	45/17	0.433	0.252
	Wish to	156/44	113/12	0.004	68/21	42/6	0.119	0.584
Spouse/ Partner	At present	152/65	117/23	0.004	68/34	41/9	0.049	0.799
	Wish to	173/25	115/11	0.277	79/10	43/3	0.365	0.762
Family member	At present	170/44	101/35	0.259	78/24	43/9	0.374	0.222
	Wish to	181/23	110/15	0.842	83/11	44/2	0.221	0.162
Friend	At present	168/50	99/38	0.308	83/20	29/23	0.001*	0.030
	Wish to	186/18	114/9	0.632	86/6	37/11	0.005	0.004
Volunteer worker	At present	38/179	32/105	0.179	21/81	15/36	0.225	0.394
	Wish to	56/142	46/79	0.109	33/56	20/28	0.109	0.555
Outdoor leisure	At present	151/67	90/46	0.544	67/34	33/19	0.723	0.726
	Wish to	163/42	108/18	0.155	84/11	39/9	0.243	0.467
Indoors leisure	At present	94/125	67/70	0.270	48/53	27/25	0.606	0.711
	Wish to	113/89	80/45	0.150	57/35	30/17	0.829	0.983
Other	At present	14/63	20/20	<0.001*	7/27	2/12	1.000	0.019
	Wish to	15/56	16/20	0.012	9/19	2/10	0.451	0.167

\*Significantly different ( $p < 0.0020$ ) at the 10-year follow-up compared with baseline.

group had a lower life satisfaction than controls concerning “Life in general”, as well as with respect to “Contacts” and “ADL” functions. Ten years after the MTBI, all participants reported reduced “Somatic health”, but only those in the intervention group experienced decreased satisfaction with respect to peers and friends. In the present study, perceived life satisfaction (15) and health (17, 18) among the participants were also reduced 10 years previously. Another follow-up study (21) confirms that the quality of life and well-being do not change after MTBI.

However, 10 years is a long time and many critical events can occur in a person’s life that may affect the outcome of quality of life instruments, regardless of any prevailing PCS. Whether or not this is the underlying reason for our results remains unknown. More information is needed about every person’s life over this time-span, in order to answer that question.

Nevertheless, the fact that the intervention group had poorer outcomes was also reflected by the fact that they drove less and more often encountered problems in preparing a meal at the 10-year follow-up. Both of these activities require executive functions and simultaneous capacity. This finding is consistent with another 10-year follow-up (22), which found that persons who had traumatic brain injuries had a worse outcome than healthy controls with respect to cognition, including executive functions. Furthermore, the SF-36 (17, 18) domains “*Bodily pain*” and “*Vitality (energy and fatigue)*” were scored lower than at the one-year follow-up for the intervention group. However, at the one-year follow-up (10) both the intervention group and

controls reported significantly poorer health-related quality of life than a Swedish reference group, a fact that also remained stable after 10 years. At this second follow-up, the intervention group were less inclined to be students, but reported that they now had roles they did not have before the MTBI. It should be noted that at baseline, 51% were between 16 and 30 years of age so it was expected that the roles would change over the subsequent 10-year period, which may explain these results. Surprisingly, however, sick leave decreased to half of the amount at the one-year follow-up, but was the same in both groups, despite the fact that controls had already recovered from MTBI one year after the injury (10). Hence, despite poorer outcomes in some aspects, the ability to work in the intervention group was not affected in comparison with the control group. A previous study found that person characteristics, injury severity and cognitive functions were not associated with vocational status (23), supporting the findings of the present study. However, sick leave data were self-reported in the present study with no confirmation from the social insurance office.

Although good recovery can be expected for most adults sustaining MTBI (5), the risk factors for a poor outcome after a MTBI remain unidentified. Some studies state that an organic structural change occurs in the brain at the acute stage of MTBI, but these changes usually resolve within 3 months (24). In a study of persons with traumatic brain injury and their relatives, a high correlation was found between their reporting of problems and neurobehavioral functioning. The same study also reported an association between subjective

reports of cognitive problems and actual test performance, but much stronger relationships were found between cognitive and emotional changes (25). However, in the present study patients with previous clinically significant brain disorders (previous brain injuries, psychiatric diseases or intellectual disabilities), a history of substance abuse and language difficulties were excluded in order to avoid confounding factors that were significantly related to poor outcomes.

Only a few intervention studies have focused on reducing the prolonged effects of MTBI (22, 26–28). A follow-up by Jacobsson et al. (28) reported that individuals with MTBI were more affected than expected. In addition, a 5–7-year follow-up found that persons after MTBI reported significantly more PCS and poorer perceived health compared with age- and sex-matched control groups (26). Another follow-up study, 5–7 years after head injury showed that poor outcomes were strongly associated with psychosocial factors (29). Several studies state that individual psychological prerequisites, pre-morbidity, and the ability to handle the situation after a MTBI are crucial outcome factors (23, 30, 31). Post-injury psychiatric morbidity, depression and pain, e.g. headache, have a strong relationship with the outcome after MTBI, in addition to work, family and friends (31, 32).

Another important factor for the outcome is that an intervention focusing on PCS may in fact increase the awareness of PCS-like symptoms in any persons (33–35). Consequently, the self-report checklists may have the unwanted consequence of teaching the person how to focus on and simulate symptoms of head injury more convincingly (34–35). The preceding RCT study (8) showed that participants reported significantly more symptoms when a list of symptoms were read for them than when they were asked to state their symptoms spontaneously. With respect to PCS, they are also claimed to be common in the normal population (30) where high rates of acute PCS have been found in persons without traumatic brain injuries. A limitation to the present study is that no information was collected about use of drugs or other therapies during the 10 years. Almost certainly there are interactions between all the factors mentioned.

Litigation or compensation may alter or mitigate possible long-term effects of MTBI (31) and, in combination with depression and pain, they could have an effect on the outcome larger than the brain injury in itself (31, 32). A limitation of the present study is that we have not investigated these factors. Further limitations are low recruitment, and as restricted by the regional ethics committee, that no drop out analysis was performed.

The conclusion of the original RCT study and the present study is that the intervention may not have the desired effect. Furthermore, individuals in the follow-up 2–8 weeks after the MTBI who declined treatment because their health issues had restored maintained the same status 10 years later. This indicates that persons who feel well within two months after a MTBI may not have any problems or reduced health related to MTBI in the future.

In summary, the 10-year follow-up showed no differences between the intervention and control groups in terms of PCS,

life satisfaction, ADL, perceived health, roles and sick leave. Over time, some minor changes occurred with respect to ADL, life satisfaction and perceived health in the intervention group. However, in both groups, sick leave decreased significantly.

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