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Comparing Traumatic Brain Injury Symptoms Reported via Questionnaires Versus a Novel Structured Interview

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Abstract

Objective: Mild traumatic brain injury (mTBI) symptoms are typically assessed via questionnaires in research, yet questionnaires may be more prone to biases than direct clinical interviews. We compared mTBI symptoms reported on two widely used self-report inventories and the novel Structured Interview of TBI Symptoms (SITS). Second, we explored the association between acquiescence response bias and symptom reporting across modes of assessment. **Method:** Level 1 trauma center patients with mTBI ($N = 73$) were recruited within 2 weeks of injury, assessed at 3 months post-TBI, and produced nonacquiescent profiles. Assessments collected included the SITS (comprising open-ended and closed-ended questions), Rivermead Post Concussion Symptoms Questionnaire (RPQ), Sport Concussion Assessment Tool-3 (SCAT-3) symptom checklist, and Minnesota Multiphasic Personality Inventory-2 Restructured Form True Response Inconsistency (TRIN-r) scale. **Results:** Current mTBI symptom burden and individual symptom endorsement were highly concordant between SITS closed-ended questions, the RPQ, and the SCAT-3. Within the SITS, participants reported significantly fewer mTBI symptoms to open-ended as compared to later closed-ended questions, and this difference was weakly correlated with TRIN-r. Symptom scales were weakly associated with TRIN-r. **Conclusions:** mTBI symptom reporting varies primarily by whether questioning is open- vs. closed-ended but not by mode of assessment (interview, questionnaire). Acquiescence response bias appears to play a measurable but small role in mTBI symptom reporting overall and the degree to which participants report more symptoms to closed- than open-ended questioning. These findings have important implications for mTBI research and support the validity of widely used TBI symptom inventories.

Keywords: Mild traumatic brain injury, Assessment, Symptom reporting, Questionnaire, Checklist, Structured interview, Open-ended interview

INTRODUCTION

Valid assessment of traumatic brain injury (TBI) symptoms is critical to clinical care and research (Broglio et al., 2014). The primary mode of symptom assessment in TBI research is self-report inventory via instruments like the Rivermead Post Concussion Symptoms Questionnaire (RPQ; King et al., 1995), the Sport Concussion Assessment Tool (SCAT; Guskiewicz et al., 2013) symptom checklist, and the Neurobehavioral Symptom Inventory (NSI; Cicerone & Kalmar, 1995). Yet questionnaire-based assessment introduces potential sources of bias and may yield information that is less valid than information obtained by other approaches such as clinical interviews (Iverson et al., 2010). Given evidence that questionnaires and interviews yield different information about TBI symptoms (Iverson et al., 2010), systematic comparisons of differing symptom assessment methods are needed to inform empirically supported research and practice guidelines.

Previous studies indicate that mild TBI (mTBI) patient and non-patient samples freely volunteer fewer mTBI symptoms than they report when prompted with specific symptoms (via questionnaire or structured interview; Gerber & Schraa, 1995; Edmed & Sullivan, 2012; Edmed & Sullivan, 2014; Edmed et al., 2015; Iverson et al., 2010; Nolin et al., 2006; Villemure et al., 2011). Similarly, patients report less severe mTBI symptoms when assessed via open-ended interview

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than questionnaires (Iverson et al., 2010; Edmed et al., 2015). These data align with studies outside the TBI field finding that direct questioning elicits more symptom reporting than open-ended questioning (Stapleton & Mills, 2008). However, limitations in the prior work make it difficult to discern the main cause of discrepant reporting and the degree to which findings apply to patients. For example, studies comparing open-ended interview to questionnaire responses confounded mode of assessment (questionnaire, interview) with the level of structure (open- vs. closed-ended) of the questions (Iverson et al., 2010; Edmed et al., 2015). Additionally, other studies included participants without TBI (university students; Edmed & Sullivan, 2012; Edmed & Sullivan, 2014; Krol et al., 2011). However, one cannot assume that mTBI-related symptoms present the same in mTBI patients vs. non-TBI samples. Relatedly, results from studies that use mock or simulated interviews may not generalize to genuine clinical assessments (Edmed & Sullivan, 2012; Edmed & Sullivan, 2014).

One concern when patients report more mTBI symptoms to questionnaires or direct questions (as compared to interview or open-ended questioning) is that excess symptoms are invalid. This concern might be supported by the finding that freely-reported symptoms, but not checklist-reported symptoms, differentiate mTBI from orthopedically injured and uninjured control groups (Gerber & Schraa, 1995). Perhaps direct questions about symptoms prompt patients to attribute ambiguous experiences to TBI (Gerber & Schraa, 1995). Such phenomena might be explained or enhanced by sources of response bias such as acquiescence bias (Baumgartner & Steenkamp, 2006; Nolin et al., 2006; Wood, 2004), the "good old days" bias (Gunstad & Suhr, 2001), or the "expectation as etiology" effect (Mittenberg et al., 1992). Others have proposed that checklists put pressure on a patient to give a response and endorse a symptom that they do not experience (Stapleton & Mills, 2008). In contrast, direct questions provide linguistic and contextual cues about a topic, which may prompt individuals who were unsure what to report to open-ended questions to acknowledge legitimate symptoms.

As compared to questionnaires, which are commonly viewed as screening tools (Decaluwé, & Braet, 2004), structured or semi-structured interviews are widely regarded as the gold standard for assessing psychiatric disorders (e.g., Davison et al., 2009; Nordgaard et al., 2012; Zimmerman, 2003). Given the vast majority of mTBI studies have relied on questionnaire-assessed symptoms, alongside evidence that this could lead to biased reporting, there may be value in assessing mTBI symptoms via interviews. As mTBI-related symptoms are not specific to mTBI and often occur in the general population (Chan, 2001; Gouvier et al., 1988; Iverson & Lange, 2003), interviews may provide a particularly strong opportunity to ascertain whether symptoms endorsed by patients were really worsened since injury or caused by the injury as opposed to reflecting preinjury or situational factors. Interviews also provide more opportunity to detect confusion about questions or contextual cues, such as the time frame in which to report symptoms.

The present study examined relationships between a novel TBI symptom interview (the Structured Interview of TBI Symptoms; SITS) with two commonly used measures of mTBI symptom reporting—the RPQ and SCAT-3 symptom checklist. To overcome some limitations of past assessment approaches, the SITS includes both open-ended and closed-ended questions as well as queries to discern preinjury from injury-related symptoms and clarify the time frame symptoms were experienced. Our primary aim was to compare the frequency and pattern of symptom endorsement across the SITS, RPQ, and SCAT-3 symptom checklist. We hypothesized that (a) symptoms would be more prevalent when assessed via structured (closed-ended) interview than open-ended interview on the SITS and (b) that a strong, positive association between structured interview (SITS closed-ended questions) and questionnaire-assessed (RPQ, SCAT-3) symptoms would be present given both of these methods elicit symptoms through direct questioning. To the degree that the instruments were not similarly associated, we expected somewhat stronger positive SITS-RPQ than SITS-SCAT-3 associations given that both the SITS and RPQ explicitly inquire about injury-related (vs. any current) symptoms. Additionally, we examined the relationship between administration order and acquiescence response bias with total symptom burden reported on the three instruments. Finally, an exploratory analysis tested whether the propensity to report fewer mTBI symptoms to open- than closed-ended interview questions was predicted by the degree to which patients felt that non-mTBI injury symptoms were more bothersome than their mTBI symptoms.

METHODS

Participants

This study was approved by the Institutional Review Board at the Medical College of Wisconsin and conducted in compliance with the Helsinki Declaration. For a thorough description of this study's recruitment procedures and participants, see Harfmann et al. (2020). In brief, 162 civilian patients with TBI were recruited from a level 1 trauma center in Milwaukee, WI in person (n = 124) or by phone (n = 38) within 2 weeks of injury. Clinical assessments were completed in-person at 3-months post-injury. Inclusion criteria were age 18 years or older, English speaking, meets the study definition of TBI, and able to provide informed consent. Exclusion criteria included prisoner population and individuals unable to provide consent (e.g., activated power of attorney). The study definition of TBI was consistent with the definition used by the American Congress of Rehabilitation Medicine (Menon-et al., 2010): *an alteration in brain function, or other evidence of brain pathology, caused by an external force*. Altered brain function was classified as any evidence of altered mental status—i.e.,

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unconsciousness, peritraumatic amnesia, or witnessed or subjective report of AMS (e.g., confusion, disorientation). TBI severity was based on admission Glasgow Coma Scale score (GCS 13-15 = mild, GCS 9-12 = moderate, GCS 3-8 = severe). Information about acute injury characteristics was obtained from a combination of chart review and semi-structured interview at the time of enrollment.

Of the 162 TBI patients enrolled, 93.8% were mTBI (17.9% with positive acute imaging findings), 1.2% were moderate TBI, and 4.9% were severe TBI. Seventy eight returned for 3-month follow-up and on average were slightly older ($M = 45.12$ years, $SD = 15.70$ years) than those who did not return ($M = 39.88$, $SD = 15.79$), $t(160) = 2.11$, $p = .036$. There were no significant differences between groups on race ($X^2[4] = 4.30$, $p = .367$), gender (Fischer's exact test $p = .531$), admission GCS ($X^2[3] = 4.63$, $p = .201$), or TBI symptom severity at enrollment (3-item RPQ total score; $t[160] = -.12$, $p = .903$). One participant who completed follow-up was removed from analyses due to the research staff observing that the participant was not adequately engaged in testing to provide valid data. Another participant was removed due to being over the recommended threshold for suspecting clinically significant acquiescence (MMPI-2 RF TRIN-r T = 88T)[1]. Of the remaining 76 participants, 96.0% sustained mTBIs, 0 sustained moderate TBI, and three sustained severe TBIs. The severe TBI cases were excluded given the current study's focus on mTBI-related symptoms and the sample size of severe TBI being insufficient to permit direct analysis of TBI severity as a moderating variable. Table 1 presents demographic and injury characteristics for the 73 participants included in analyses.

Procedures

At enrollment (< 2 weeks post-injury), patients completed a demographic questionnaire and the 3-item RPQ estimate of acute TBI symptom severity. The 3-month follow-up ($M = 91.7$ days, $SD = 4.9$) assessment was completed in-person and comprised the Wide Range Achievement Test-4th edition (WRAT-4) Word Reading test, followed by questionnaire and interview measures of TBI symptoms (described in the next section), quality of life (QoL), and return to pre-injury functioning relevant to address the aims of the parent study. Each participant was assigned to one of four administration orders to counterbalance the order of administration within and across outcome domains (symptoms, function, QoL). The orders were created to ensure some separation in time between instruments of the same domain, as well as a different order of presentation of each instrument. Thus, TBI symptom measures were counterbalanced in order and intermingled with other measures (e.g., QoL). Although we intended to assign orders sequentially, because subject files were produced in advance and some subjects were lost to follow-up, we later strayed from this approach by filling in small order groups to ensure similar order group sizes.

The WRAT-4 (Wilkinson & Robertson, 2006) Word Reading test was administered to estimate reading level. When performance indicated less than a 6th grade reading level, research staff read the questionnaires to participants whenever feasible. However, this protocol was not consistently followed, in part because some participants requested that questionnaires be read to them, and examiners were instructed to flex procedures within their judgment to prioritize getting through the examination whenever possible. Overall, nine (12.3%) participants had a WRAT-4 Word Reading grade estimate below the 6.0 grade level, but eight (11.0%) participants had questionnaires read to them and six (8.2%) had a combination of independently reading questionnaires and having the questionnaire read to them. As reported in the Results, sensitivity analyses confirmed that primary findings were not affected by the subset of individuals who did not independently read the questionnaires.

Clinical Assessment Measures

The RPQ (King et al., 1995) is a 16-item questionnaire that assess symptom severity (relative to preinjury symptoms) over the past 24 hours on a 5-point scale (0 = not experienced at all to 4 = a severe problem). Ratings of 1 (no more of a problem than preinjury) are recoded to 0, and item ratings are summed to produce a total symptom severity score (0–64). Items were considered endorsed if rated 2–4. A 3-item RPQ (composed of the first three symptoms from the questionnaire: headache, dizziness, and nausea) was administered at enrollment to estimate baseline symptom severity. The full RPQ was administered at follow-up.

The SCAT-3 (Guskiewicz et al., 2013) is a 22-item questionnaire that assesses current symptom severity on a 7-point scale (0 = none to 6 = severe). Ratings are summed to produce a symptom severity score (range 0–132).

The Minnesota Multiphasic Personality Inventory-2 Restructured Form (MMPI-2-RF; Ben-Porath & Tellegen, 2008) is a questionnaire of personality and psychopathology administered as true/false items. Specific MMPI-2-RF scales were administered (TRIN, RC1, FBS; 87 items total) in the parent study, as it was infeasible to collect the entire instrument. The TRIN-r scale was relevant to the present study and was included to assess acquiescence response bias.

The SITS was developed for this study to assess TBI symptoms using both open- and closed-ended question formats. An initial draft of the interview was reviewed by four experts in the field who provided feedback, and revisions were made before the SITS was piloted on the study sample. The SITS version administered comprised four parts; however, only data from parts one and two were used in the current study and will be described in detail here. Part one consisted of open-ended questions about any symptoms experienced *since injury*. Participants were asked (1) *"Tell me about the injuries you had as a result of your [fall/*

[1]We acknowledge that for analyses associating acquiescence with other constructs, including as a wide a range of TRIN-r scores as possible would have been reasonable. Thus, we also ran analyses with this 1 additional participant in the data set and confirmed that it did not have a meaningful effect on any of the main conclusions.

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Table 1. Sample characteristics

	M (SD); Med (IQR); or *N (%)*
Age (years)	45.2 (15.5)
Education (years)	12.9 (2.0)
Gender (male)	41 (56.2%)
Race	
White	37 (50.7%)
Black	31 (42.5%)
Unknown	3 (4.1%)
Not reported	2 (2.7%)
Injury characteristics	
Level of care	
Emergency department	43 (58.9%)
Inpatient unit	30 (41.1%)
Cause of injury	
Motor vehicle traffic accident	47 (64.4%)
Fall	15 (20.5%)
Assault	6 (8.2%)
Struck by/against	4 (5.5%)
Other	1 (1.4%)
Loss of consciousness[1]	43 (58.9%)
Posttraumatic amnesia[1]	44 (60.3%)
Retrograde amnesia[1]	18 (24.7%)
Positive head CT	18 (24.7%)
Clinical Characteristics Evaluated at 3 Months Post-Injury	
WRAT-4 Word Reading (Standard Score)	93.1 (15.5)
MMPI-2-RF TRIN-r raw score	10.9 (1.2)
MMPI-2-RF TRIN-r T score	56.6 (6.3)
MMPI-2-RF TRIN-r T score (False Direction)	$N = 26$ (35.6%)
MMPI-2-RF TRIN-r T score (True Direction)	$N = 21$ (28.8%)
RPQ Total Symptom Severity	15.7 (16.7); 10.0 (2.0–26.0)
SCAT-3 Total Symptom Severity	21.8 (25.0); 11.0 (2.0–36.0)
SITS Total Number of Symptoms-Open-Ended (any since injury)	4.1 (2.0); 4.0 (3.0–5.0)
SITS Total Number of Symptoms-Closed-Ended (any since injury)	17.8 (7.3); 18.0 (13.0–23.0)
SITS Total Number of Symptoms-Closed-Ended (current at 3 months)	9.9 (8.2); 8.0 (3.0–18.0)

$N = 73$ mTBI participants (Glasgow Coma Scale scores 13–15) for all measures except for the MMPI-2 RF TRIN-r ($N = 71$) and SITS open-ended questions ($N = 71$). WRAT-4 = Wide Range Achievement Test, 4th edition; MMPI-2-RF TRIN-r = Minnesota Multiphasic Personality Inventory-2 Restructured Form True Response Inconsistency; RPQ = Rivermead Post Concussion Symptoms Questionnaire; SCAT-3 = Sport Concussion Assessment Tool-3 symptom checklist; SITS = Structured Interview of TBI Symptoms; IQR = interquartile range.
[1] Witnessed and suspected categories collapsed.

accident, etc.]," then, (2) *"Tell me about the symptoms you had after your (concussion/traumatic brain injury/injury)."*

Part two was a structured, closed-ended interview of 31 symptoms. The examiner instructed participants that they would be asked specific questions about symptoms they may have experienced as a result of their concussion/TBI. Participants were read the list of TBI symptoms using various question prompts (A–D). The items were selected to cover the content assessed by the RPQ, SCAT-3, and NSI because these are the main instruments used in the civilian, athlete, and military TBI populations, respectively. A final item (question 32) asked the participant to report on any "other" TBI symptoms experienced that were not included on the list. Prompt A asked: *"Has [symptom] ever been a problem after your injury?"* If the symptom was endorsed on prompt A, prompt B was administered next: *"Was this problem something you dealt with before your injury?"*. If prompt B was endorsed, prompt C was administered: *"Was this problem worse or more frequent after your injury?"*. If prompt B was answered "no", prompt D1 was administered: *"Is this still a problem (i.e., in the past week)?"* If prompt C was endorsed, prompt D2 was administered: "*Is this problem still worse than it was before your injury (i.e., in the past week?)."* Two SITS closed-ended question scores were calculated, reflecting the number of *any* symptoms experienced *since injury* (Prompt A responses) and any *current*, *injury-related* symptoms (Prompt D; range 0–32).

Interviewers recorded participant responses onto paper forms, which were double entered by two individuals and reconciled by a third rater in cases of entry inconsistencies. Coding of open-ended question responses used an approach similar to other studies (e.g., Edmed & Sullivan, 2012; Edmed & Sullivan 2014; Edmed et al., 2015; Iverson et al., 2010). Responses were coded (by two independent raters) as being either consistent (score = 1) or inconsistent (score = 0) with the 31 items asked about during closed-ended questioning from part two. Responses deemed synonyms of items from closed-ended questions were coded as the closest closed-ended question item (e.g., "worried" reported during open-ended questioning was recorded under "feeling anxious or nervous"). Responses deemed similar but too vague to be declared any particular TBI symptom were coded as an "other" TBI symptom (e.g., "vision change," "feels slow"). Responses that were inconsistent with TBI symptoms were not scored (e.g., "disbelief," "feeling dependent"). Symptoms reported to open-ended questioning were summed to produce an index that paralleled the total number of symptoms score to closed-ended prompt A responses (i.e., reflecting any TBI symptoms experienced *since* injury).

Finally, participants were asked about whether TBI or non-TBI injury symptoms were more bothersome and, while not included in the present study, were questioned about overall severity and duration of TBI and peripheral/non-TBI symptoms.

Statistical Analyses

Statistical analyses were performed with SPSS version 24.0 with the exception of multiple comparison correction (performed in R version 3.5.2). Alpha was set to .05. Data were

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complete for all clinical assessment outcome measures except the SITS open-ended interview question, for which one interviewer neglected to record the participant's response ($n = 71$) and the MMPI-2-RF TRIN-r ($n = 71$). Because of skew in the RPQ, SCAT-3, and the SITS closed-ended question scores, nonparametric statistics were used for the main analyses.

Spearman's ρ correlation coefficients examined associations among symptom severity and TRIN-r raw score variables, with 95% confidence intervals computed using syntax from Bonett and Wright (2000). Correlation strength was interpreted using guidelines from Dancey and Reidy (2007): .10 to .39 = weak, .40 to .69 = moderate, and .70 to .99 = strong. Cochran's Q (three-group comparisons) and McNemar's (two-group comparisons) analyses examined differences in the prevalence of symptom endorsement across measures. The false discovery rate (FDR) control method (Benjamini & Hochberg, 1995) was used to correct for multiple comparisons. Only items that were the same across all three symptom assessment instruments (12 items) were included when comparing the questionnaires to the closed-ended interview questions. Wilcoxon signed-rank and Friedman's analysis of variance tests were used to compare the total number of post-injury symptoms reported across assessment instruments. Kruskal–Wallis H tests for independent samples examined potential effects of administration order on TBI total symptom scores, and Mann–Whitney tests were used for follow-up pairwise comparisons with *r* as a measure of effect size (Field, 2013). Mann–Whitney tests also compared predominant symptom-type groups (non-TBI vs. TBI more bothersome) on the number of symptoms reported to open-ended interview questions and on the difference in symptoms reported to closed- vs. open-ended interview questions.

RESULTS

TBI Symptom Reporting: Open- vs. Closed-Ended Interview Questions

Mean and median number of symptoms reported across TBI measures are displayed in Table 1. At 3-month follow-up, participants retrospectively reported experiencing significantly more symptoms *since injury* on the SITS closed-ended questions (i.e., prompt A items) compared to the SITS open-ended questions ($z = 7.33$, $p < .001$, $r = .62$). A difference score was calculated (closed-ended minus open-ended total symptoms; *Mdn* = 14 symptoms, range 2–27). Table 2 displays the percentages of individual symptoms experienced *since injury* that were retrospectively reported at 3 months during the SITS open- and closed-ended questioning. Across all 31 TBI symptoms, the prevalence of endorsement was significantly higher via closed- than open-ended interview questioning. Results remained significant after FDR correction was applied (*p's* < .001). There was no significant difference in number of "other" TBI symptoms reported to open- and closed-ended questions ($p = .250$).

TBI Symptom Reporting: Closed-Ended Interview Questions and Questionnaires

Table 3 displays the percentage of individual symptoms experienced *currently* at 3-month follow-up and deemed injury related (new or worsened since preinjury) on the SCAT-3, RPQ, and SITS-closed-ended questions (i.e., responses to prompt D) for the 12 items that overlapped across measures. No comparisons between the three instruments were significant after FDR correction. Results remained the same when analyses were computed including only the subset of participants who independently read their own questionnaires ($N = 59$). Total number of *current, injury-related* symptoms reported (among the 12 overlapping symptoms) were not significantly different across the measures, χ_F^2 (2) = 4.82, $p = .090$.

Correlations among symptom measures are provided in Table 4. Results of correlations showed that at 3-month follow-up, higher total number of *current injury-related* symptoms on the SITS closed-ended questions (i.e., prompt D responses) was strongly and positively associated with greater total severity of current symptoms measured by the RPQ and the SCAT-3 (*p*'s < .001). The SITS-RPQ association was significantly stronger than the SITS-SCAT-3 association ($z = -2.59$, $p = .009$).

Relationships Between TBI Symptoms and Acquiescence Bias

Correlations between TBI symptom measures and the MMPI-2 RF TRIN-r are reported in Table 4. Higher levels of acquiescence bias (TRIN-r raw score) were weakly and positively associated with higher *current* symptom burden on SCAT-3 and SITS closed-ended questions (*p's* < .05) and greater difference between number of symptoms (any *since* injury) reported to closed- vs. open-ended SITS questions ($p = .008$). The association between *current* symptom burden on the RPQ and acquiescence failed to reach significance, though trended in that direction ($p = .06$). The association between acquiescence and total number of symptoms (any *since* injury) reported to SITS open-ended questions was not significant ($p = .326$).

Effects of Test Administration Order on TBI Symptom Reporting

Effects of test administration order on symptom reporting are summarized in Table 5. There were no significant effects of order on symptom burden reported to the SITS closed-ended questions (current injury-related symptoms), the RPQ or the SCAT-3 symptom checklist (*p's* > .05). However, order was related to number of symptoms reported to the SITS open-ended question (any symptoms since injury; $p = .008$, $\eta^2 = .083$). Follow-up pairwise comparisons with adjusted *p*-values demonstrated that more symptoms were reported to open-ended interview when the SITS was administered third compared to first ($z = -2.99$, $p = .008$, $r = .41$). There

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Table 2. Prevalence of TBI symptoms retrospectively recalled as occurring between injury and 3-month assessment for open-ended versus closed-ended interview methods

Symptom	SITS Open-Ended (Any Since Injury)	SITS Closed-Ended (Any Since Injury)	*p*
Headaches	67.6%	84.5%	**<.001**
"Pressure in head"	2.8%	56.3.%	**<.001**
Neck pain	23.9%	71.8%	**<.001**
Nausea or vomiting	32.4%	52.1%	**<.001**
Feeling dizzy	52.1%	77.5%	**<.001**
Balance problems	11.3%	62.0%	**<.001**
Poor coordination	0.0%	39.4%	**<.001**
Blurred vision	5.6%	38.0%	**<.001**
Double vision	4.2%	19.7%	**<.001**
Hearing difficulty	8.5%	25.4%	**.004**
Numbness or tingling on parts of your body	12.7%	62.0%	**<.001**
Changes in sense of smell and/or taste	1.4%	21.1%	**<.001**
Sensitivity to light (easily upset by bright light)	11.3%	52.1%	**<.001**
Sensitivity to noise (easily upset by loud noise)	7.0%	50.7%	**<.001**
Taking longer to think	5.6%	77.5%	**<.001**
Poor concentration	11.3%	66.2%	**<.001**
Forgetfulness or poor memory	32.4%	73.2%	**<.001**
Difficulty making decisions	0.0%	43.7%	**<.001**
Confusion	12.7%	53.5%	**<.001**
Feeling like you're "in a fog"	7.0%	45.1%	**<.001**
Fatigue (getting tired more easily)	19.7%	78.9%	**<.001**
Drowsiness	2.8%	69.0%	**<.001**
Restlessness	4.2%	59.2%	**<.001**
Sleep problems	15.5%	69.0%	**<.001**
Loss of appetite/increased appetite	4.2%	43.7%	**<.001**
Feeling frustrated or impatient	2.8%	66.2%	**<.001**
Being irritable or easily angered	12.7%	56.3%	**<.001**
Feeling depressed or sad	9.9%	54.9%	**<.001**
Feeling nervous or anxious	7.0%	47.9%	**<.001**
Feeling more emotional	7.0%	63.4%	**<.001**
"Don't feel right"	4.2%	71.8%	**<.001**
Other	9.9%	5.6%	.250

$N = 71$. SITS = Structured Interview of TBI Symptoms. Results of McNemar's analyses comparing percentages of symptoms on open-ended questioning and closed-ended questioning of any symptoms experienced after injury (asked at 3 months post-injury). Bolded *p* values are significant after FDR correction for multiple comparisons. Other TBI-like symptoms reported included symptoms that did not clearly match the 31 primary symptoms, such as visual problems, hearing problems, anxiety or mood symptoms (e.g., frightened, fear, jumpy, worried, panicky, mood swings, and angry/aggressive), and cognitive symptoms (e.g., slowness in brain functions, repeating self, and feeling dazed).

was a trend for more symptoms reported when the open-ended question was administered second (vs. first; $z = -2.36$, $p = .054$, $r = .38$) and no difference between administration order 2 and 3 ($z = -.33$, $p > .999$, $r = .04$).

Association Between Predominant Symptom Type and SITS TBI Symptom Responses

Most of the sample experienced a combination of TBI and other injuries, leading us to question whether symptom reporting to different question types might be predicted by the predominant source of injury symptoms experienced by the patients. An exploratory analysis found that 50.7% of the sample endorsed their TBI symptoms as more bothersome and 49.3% endorsed their non-TBI injury symptoms as more bothersome. Total number of symptoms experienced *since injury* reported to SITS open-ended questions did not differ between those who were more bothered by TBI symptoms ($Mdn = 3.5$) than those who were more bothered by other injury symptoms ($Mdn = 4.0$), $U = 623.00$, $z = .34$, $p = .73$, $r = .04$. However, the difference between number of symptoms reported to closed- vs. open-ended interview questions was significantly greater for the group who endorsed their TBI symptoms as more bothersome ($Mdn = 16.0$) compared to the group that endorsed their non-TBI symptoms as more bothersome ($Mdn = 11.0$), $U = 367.50$, $z = -2.74$, $p = .006$, $r = .33$.

DISCUSSION

The current study investigated relationships between mTBI symptoms assessed via a novel TBI interview (the SITS)

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Table 3. Percentage of TBI symptoms experienced currently (at 3-month follow-up) by assessment instrument

Symptom	SCAT-3	RPQ	SITS Closed-Ended (Current Symptoms)	*Q*	*p*
Headache	34.2%	38.4%	37.0%	.67	.717
Nausea	15.1%	13.7%	17.8%	1.17	.558
Dizziness	28.8%	32.9%	35.6%	1.58	.453
Blurred vision	17.8%	20.5%	23.3%	1.85	.397
Light sensitivity	31.5%	26.0%	28.8%	1.71	.424
Noise sensitivity	31.5%	27.4%	28.8%	.93	.627
Difficulty concentrating	43.8%	34.2%	42.5%	4.10	.129
Forgetful	50.7%	43.8%	41.1%	4.59	.101
Fatigue	57.5%	52.1%	53.4%	1.18	.554
Difficulty with sleep	47.9%	41.1%	38.4%	2.89	.236
Irritability	39.7%	42.5%	35.6%	2.11	.348
Depression/sadness	49.3%	35.6%	38.4%	7.30	.026

$N = 73$. RPQ = Rivermead Post Concussion Symptoms Questionnaire; SCAT-3 = Sport Concussion Assessment Tool-3 symptom checklist; SITS = Structured Interview of TBI Symptoms. Closed-ended responses represent current injury-related symptoms experienced at 3-month follow-up. Cochran's Q analyses restricted to symptoms represented across all TBI instruments. No statistical tests were significant after correction for multiple comparisons.

Table 4. Spearman's correlations across TBI symptom measures and acquiescence response bias

	SITS Open[2]		SITS Difference[3]		SCAT-3		RPQ		MMPI-2-RF TRIN-r	
	ρ	95% CI	ρ	95% CI	ρ	95% CI	ρ	95% CI	ρ	95% CI
SITS Closed[1]	.40**	(.17, .58)	.79**	(.66, .87)	.82**	(.70, .89)	.89**	(.81, .93)	.26*	(.03, .47)
SITS Open[2]			.23	(−.01, .44)	.31**	(.08, .51)	.32**	(.08, .52)	.12	(−.12, .35)
SITS Difference[3]					.71**	(.55, .82)	.72**	(.56, .82)	.32**	(.08, .52)
SCAT-3							.88**	(.79, .93)	.27*	(.03, .47)
RPQ									.22	(−.01, .44)

SITS = Structured Interview of TBI Symptoms; SCAT-3 = Sport Concussion Assessment Tool-3 symptom checklist symptom severity score; RPQ = Rivermead Post Concussion Symptoms Questionnaire symptom severity score; MMPI-2-RF TRIN-r = Minnesota Multiphasic Personality Inventory-2 Restructured Form True Response Inconsistency raw score.
* 2-tailed $p < .05$, ** $p < 0.01$
[1] Number of current (3-month) injury-related symptoms reported to closed-ended questions, selected to maximize comparability to SCAT-3 and RPQ scores.
[2] Number of symptoms reported to open-ended questions (any since injury).
[3] Closed-ended vs. open-ended symptom difference score (any since injury).

and well-established self-report inventories. We compared the frequency and pattern of symptom endorsement across these measures and explored the association between symptom reporting and acquiescence response bias. The key findings of this study include (1) mTBI symptom endorsement is highly concordant between closed-ended interview questions and questionnaires; (2) symptom reporting varies by level of question structure (open- vs. closed-ended), when comparing instruments equivalent in mode of assessment (i.e., within an interview); and (3) symptom endorsement to closed-ended questions, as well as the propensity to report more symptoms to closed- than open-ended questions, is significantly but weakly related to acquiescence.

Consistent with hypotheses, we found strong, positive correlations between the SITS closed-ended questions with the RPQ and SCAT-3 symptom checklist, as well as similar rates of symptom endorsement across these three measures, suggesting these measures are highly concordant. The stronger association between the SITS and RPQ than between the SITS and the SCAT-3 could be related to the SITS and RPQ both assess symptoms relative to preinjury, whereas the SCAT-3 checklist merely solicits current symptom burden. The strong concordance of ratings across the three measures may result from the highly structured questioning across the instruments. In contrast, consistent with hypotheses and prior work (Gerber & Schraa, 1995; Edmed et al., 2015; Iverson et al., 2010; Nolin et al., 2006; Villemure et al., 2011), patients reported substantially more symptoms to closed-ended (vs. open-ended) interview questions, implying a stronger effect of question structure than mode of assessment (interview, questionnaire) on mTBI symptom reporting.

Our finding that TRIN-r was positively correlated with the closed- vs. open-ended difference score suggests that acquiescence response bias may play a small role in examinees' tendencies to endorse more symptoms to closed-ended/direct questions. However, the weak size of this relationship implies that other mechanisms likely contribute to increased

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Table 5. Descriptive statistics and statistical comparison of effect of administration order on symptom endorsement

	Administered First	Administered Second	Administered Third			
	N, Mean Rank	*N, Mean Rank*	*N, Mean Rank*	*H*	*p*	η^2
SITS open-ended[1]	*N* = 20, 23.68	*N* = 20, 39.29	*N* = 33, 41.20	9.61	**.008**[3]	.083
Mdn (*IQR*)	3.0 (2.0–4.0)	4.0 (3.0–6.0)	4.0 (3.0–5.5)			
SITS closed-ended[2]	*N* = 20, 32.33	*N* = 20, 43.45	*N* = 33, 35.98	2.95	.229	.015
Mdn (*IQR*)	8.0 (2.0–10.8)	18.0 (2.0–20.0)	7.0 (3.0–14.0)			
SCAT-3	*N* = 16, 32.72	*N* = 37, 34.96	*N* = 20, 44.20	3.31	.191	.010
Mdn (*IQR*)	8.5 (2.0–18.8)	10.0 (2.0–33.5)	32.5 (3.3–56.8)			
RPQ	*N* = 37, 40.20	*N* = 16, 36.81	*N* = 20, 31.23	2.36	.307	.023
Mdn (*IQR*)	10.0 (2.0–36.0)	12.5 (0.5–25.3)	5.0 (0.0– 18.5)			

SITS = Structured Interview of TBI Symptoms; SCAT-3 = Sport Concussion Assessment Tool-3; RPQ = Rivermead Post Concussion Questionnaire. Results of Kruskal–Wallis H test.
[1] Number of symptoms reported to open-ended questions (any since injury).
[2] Number of current (3-month) injury-related symptoms reported to closed-ended questions, selected to maximize comparability to SCAT-3 and RPQ scores.
[3] More symptoms reported to open-ended questions when the SITS was administered third compared to first.

symptom endorsement to closed-ended questioning more so than acquiescence. Secondary analyses ruled out that patients who endorsed relatively few symptoms to open- than closed-ended questions were simply more preoccupied with non-TBI injury symptoms. In contrast, patients who were more relatively bothered by their mTBI (vs. other injury) symptoms tended to report even more new symptoms to closed- than open-ended questioning.

It is also possible that subtle differences in how open- vs. closed-ended interview questions were framed contributed to the symptoms reported in these subsections of the interview. Following open-ended questioning, the most commonly reported symptoms were headache, dizziness, nausea/vomiting, and forgetfulness. These symptoms closely align with those identified by others to be typical acute symptoms (i.e., headache, dizziness, and nausea per Eyres et al., 2005; Ryan & Warden, 2003), which may suggest that the open-ended question prompted participants to reflect on their acute experience of symptoms. In contrast, the most common symptoms endorsed *since injury* to closed-ended questioning were headache, fatigue, dizziness, and taking longer to think. The closed-ended question prompt called for any symptoms recognized between injury and the 3-month interview, which may have prompted subjects to report symptoms that were not immediately noticeable or not attributed by participants to TBI given their expectancies and knowledge about traumatic injuries.

We also found evidence of a dose–response relationship between number of mTBI symptom questionnaires administered before the interview and number of symptoms freely reported to open-ended interview questions, with more symptoms freely reported when other mTBI checklists were administered first. Despite these order effects for the open-ended questions, participants still freely volunteered fewer symptoms overall compared with the number of symptoms reported to the closed-ended questions (*Mdn* = 18 to closed-ended questioning vs. 3–4 to open-ended questioning depending on administration order). This may provide support for Iverson et al.'s (2010) hypothesis that checklists remind patients of symptoms they forgot they had. Alternatively, perhaps exposure to questionnaires clarified what examiners meant by "TBI symptoms."

While not assessed in the current study, researchers have suggested that some patients may report fewer symptoms during an interview because they feel rushed or uncomfortable discussing symptoms (Iverson et al., 2010). Anecdotally, our participants have occasionally reported that they perceived the symptom prompts of purportedly different symptoms to reflect the same symptom to them, implying repetition of content that inflates perceived differences between responses to open- and closed-ended questions.

The study findings have several clinical and research implications. First, clinicians should recognize that how they frame and structure questioning about symptoms can significantly influence the number and types of symptoms reported by their patients (Edmed & Sullivan, 2014). This is particularly important because it can be difficult for clinicians to plan treatments when they get conflicting information about patients' symptoms across different assessment instruments (Kondiles et al., 2015) or when using different types of questioning. The findings are also important to consider in research settings, where direct assessment of symptoms via questionnaires has predominated. In particular, the high concordance between different instruments that employed direct questioning implies that research findings that used one instrument may generalize to other similar instruments. On the other hand, given uncertainty around why symptom reporting differs markedly between open- and closed-ended question formats, research findings cannot be readily compared across studies that employ different levels of question structure. Thus, researchers should always clearly report how they assessed symptoms (Krol et al., 2011). Investigating alternative hypotheses regarding the cause of discrepant information obtained across approaches would be valuable to continue to advance evidence-based assessment strategies.

The strong concordance across the SITS closed-ended questions, the RPQ, and the SCAT-3 symptom checklist supports the validity of symptoms assessed by the SITS.

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However, these measures should not be used interchangeably, as the SITS and other symptom interviews are likely to add additional clinically relevant information not assessable with a brief, structured symptom checklist. For example, open-ended questions help identify symptoms that are most problematic for the patient, which may help identify symptom-specific treatments that the patient may benefit from (Edmed et al., 2015). Additionally, the SITS explicitly queries patients about preinjury symptoms and participants' peripheral/non-TBI injury symptoms, which were more bothersome than TBI symptoms for half of the sample. Such additional information gained is critical to provide patient-centered care, particularly in civilian polytrauma populations where comorbidities are prevalent.

Limitations

This study had several novel strengths including using multiple methods of TBI assessment and levels of question structure (open-ended questions, closed-ended questions, and questionnaires), consideration of examinee reading level, individually proctored assessments to provide participants with the questionnaire instructions, and counterbalanced administration of symptom measures. On the other hand, limitations of the study included the relatively small sample size and attrition rate between enrollment and 3-month follow-up. However, other than being slightly older than those who were lost to follow-up, there were no other differences on demographic or injury characteristics between those who did vs. did not return, so we do not believe this substantially skewed the findings. While reassuring that no other measured variables predicted loss to follow-up, unfortunately the reasons for attrition are unclear. Because the most robust predictor of 3-month symptoms (acute symptom severity) was not predictive of follow-up, and the mean 3-month RPQ score is consistent with the literature in this population (e.g., Sigurdardottir et al., 2009), it seems unlikely that those who returned for follow-up had more or less prolonged symptoms than those lost to follow-up.

The lack of symptom validity tests may be considered a limitation. However, we were primarily interested in comparing instruments and had no reason to suspect that potential overreporting/underreporting in some participants would differentially affect the relationship between instruments.[2] Administration of an abbreviated MMPI-2 RF may have altered the meaning of the TRIN-r scale. However, administration of the entire MMPI-2 RF was impractical and not relevant to the primary aims of our study. The order effects observed on open-ended symptom reporting may be considered a limitation. Using only those who were administered the SITS open-ended question first ($n = 20$), correlations among instruments continued to demonstrate high concordance between the SITS closed-ended questions and TBI symptom checklists, yet this subset of the data are too small to draw firm conclusions about this or other analyses.

[2]While the MMPI-2 RF FBS scale was administered in the parent study, FBS data were not included in the current study for several reasons: 1) review of the literature conducted during the study revealed significant concerns, including the FBS scale is not adequately validated as a measure of response validity in civilian trauma research or clinical samples (e.g., see Butcher et al., 2008; Gass & Odland, 2012); 2) exploration of our data further supported that FBS may not behave in this sample as it would be expected to if it were a measure of overreporting (e.g., neither FBS raw scores nor the percentage of individuals over the clinical cut score were associated with self-reported involvement in injury-related litigation); and 3) as our primary aim was to investigate correlations among similar symptom scales, we did not expect that systematic overreporting in some individuals would adversely bias estimated correlations between variables—if anything, it seemed more likely that scales like the FBS would capture bonafide symptoms in our population and that reducing the range of symptoms would limit the valid estimation of correlations between the primary variables of interest.

Conclusions

This study demonstrated that self-report of mTBI symptoms varies by form of question structure but is highly concordant between widely used questionnaires and a novel structured interview. Acquiescence bias appears to play a small role in the additional symptoms reported to closed- vs. open-ended questions. The findings help inform selection of clinical outcome measures for mTBI studies. Findings also support the continued use of the RPQ and SCAT-3 symptom checklists to assess mTBI-related symptoms (at least under the carefully proctored conditions of this study), even if those symptoms might warrant follow-up queries to discern if symptoms were related to the mTBI or not (e.g., if symptoms existed premorbidly or related to interim circumstances). Additional study of when and why participants endorse more symptoms to closed-ended questions is warranted. Structured interviewing (e.g., with the SITS) may provide additional valuable information about patients' symptom context, trajectories, and experiences that, when practical to administer, could better inform clinical management decisions and spark more informed research to mitigate the burden of mTBI symptoms on patients.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to report.

REFERENCES

Baumgartner, H., & Steenkamp, J.E.M. (2006). Response bias in marketing research. In R. Grover & M. Vriens' (Eds.), *The handbook of marketing research: Uses, misuses, and future advances* (pp. 95–109). Thousand Oaks, CA: Sage Publications, Inc.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B*, *57*, 289–300.

Ben-Porath, Y. S., & Tellegen, A. (2008). *MMPI–2–RF (Minnesota Multiphasic Personality Inventory–2 Restructured Form): Manual for administration, scoring, and interpretation*. Minneapolis, MN: University of Minnesota Press.

Bonett, D.G., & Wright, T.A. (2000). Sample size requirements for estimating Pearson, Kendall, and Spearman correlations. *Psychometrika*, *65*(1), 23–28.

Broglio, S.P., Cantu, R.C., Goia, G.A., Guskiewcz, K.M., Kutcher, J., Palm, M., & Valovich McLeod, T.C. (2014). National Athletic Trainers' Association Position Statement: Management of Sport Concussion. *Journal of Athletic Training*, *49*(2), 245–265.

Butcher, J.N., Gass, C.S., Cumella, E., Kally, Z., & Williams, C.L. (2008). Potential for bias in MMPI-2 assessments using the Fake Bad Scale (FBS). *Psychological Injury & Law*, *1,* 191–209. doi: 10.1007/s12207-007-9002-z

Chan, R.C. (2001). Base rate of post-concussion symptoms among normal people and its neuropsychological correlates. *Clinical Rehabilitation*, *15*(3), 266–273.

Cicerone, K.D., & Kalmar, K. (1995). Persistent postconcussion syndrome: The structure of subjective complaints after mTBI. *Journal of Head Trauma Rehabilitation*, *10,* 1–17.

Dancey, C.P., & Reidy, J. (2007). *Statistics without maths for psychology* (4th edition). Harlow, England: Pearson/Prentice Hall.

Davison, T.E., McCabe, M.P., & Mellor, D. (2009). An examination of the "gold standard" diagnosis of major depression in age-care settings." *American Journal of Geriatric Psychiatry*, *17*(5), 359–367.

Decaluwé, V., & Braet, C. (2004). Assessment of eating disorder psychopathology in obese children and adolescents: interview versus self-report questionnaire. *Behaviour Research and Therapy*, *42*(7), 799–811. Doi: 10.1016/j.brat.2003.07.008.

Edmed, S., & Sullivan, K.A. (2012). Base rates of postconcussion syndrome by method of symptom report. *Applied Neuropsychology: Adult*, *19*, 164–170. doi: 10.1080/09084282.2011.643961

Edmed,S., & Sullivan, K.A. (2014). Method of symptom assessment influences cognitive, affective and somatic post-concussion-like symptom base rates. *Brain Injury*, *28*(10), 1277–1282. doi: 10.3109/02699052.2014.915988

Edmed, S., Sullivan, K.A., Allan, A.C., & Smith, S.S. (2015). Assessment method influences the severity and type of symptoms reported after self-reported mild traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology*, *37*(6), 641–652. doi: 10.1080/13803395.2015.1038984

Eyres, S., Carey, A., Gilworth, G., Neumann, V., & Tennent, A. (2005). Construct validity and reliability of the Rivermead Post-Concussion Symptoms Questionnaire. *Clinical Rehabilitation*, *19,* 878–887.

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics* (4th ed.). Los Angeles, CA: SAGE Publications Ltd.

Gass, C.S., & Odland, A. (2012). Minnesota Multiphasic Personality Inventory–2 Revised Form Symptom Validity Scale–Revised (MMPI–2–RF FBS–r; also known as Fake Bad Scale): Psychometric characteristics in a nonlitigation neuropsychological setting. *Journal of Clinical and Experimental Neuropsychology*, *34*(6), 561–570. doi: 10.1080/13803395.2012.666228

Gerber, D.J., & Schraa, J.C. (1995). Mild traumatic brain injury: Searching for the syndrome. *Journal of Head Trauma Rehabilitation*, *10*(4), 28–40.

Gouvier W.D., Uddo-Crane, M., & Brown, L.M. (1988). Base rates of postconcussional symptoms. *Archives of Clinical Neuropsychology*, *3,* 273–278.

Gunstad, J., & Suhr, J.A. (2001). "Expectation as etiology" versus "the good old days": Postconcussion syndrome symptom reporting in athletes, headache sufferers, and depressed individuals. *Journal of the International Neuropsychological Society*, *7*, 323–333.

Guskiewicz, K.M., Register-Mihalik, J., McCrory, P., McCrea, M., Johnston, K., Makdissi, M. . . . Meeuwisse, W. (2013). Evidence-based approach to revising the SCAT2: Introducing the SCAT3. *British Journal of Sports Medicine*, *47*, 289–293.

Harfmann, E.J., deRoon-Cassini, T.A., McCrea, M., Nader, A., & Nelson, L. (2020). Comparison of four quality of life inventories for patients with traumatic brain injuries and orthopedic injuries. *Journal of Neurotrauma*, epub ahead of print, doi.org/10.1089/neu.2019.6746

Iverson, G.L., Brooks, B.L., Ashton, V.L., & Lange, R.T. (2010). Interview versus questionnaire symptom reporting in people with the postconcussion syndrome. *Journal of Head Trauma Rehabilitation*, *25*(1), 23–30.

Iverson, G.L., & Lange, R.T. (2003). Examination of "postconcussion-like" symptoms in a healthy sample. *Applied Neuropsychology*, *10*, 137–144.

King, N., Crawford, S., Wenden, F., Moss, N., & Wade, D. (1995) The Rivermead Post Concussion Symptoms Questionnaire: A measure of symptoms commonly experienced after head injury and its reliability. *Journal of Neurology*, *242*, 587–592.

Kondiles, B., Starr, C.R., Larson, E.B., & Zollman, F. (2015). Method of assessment and symptom reporting in veterans with mild traumatic brain injury. *Health Psychology and Behavioral Medicine*, *3*(1), 1–11. doi: 10.1080/21642850.2014.966717

Krol, A., Mrazik, M., Naidu, D., Brooks, B.L., & Iverson, G.L. (2011). Assessment of symptoms in a concussion management programme: Method influences outcome. *Brain Injury*, *25*(13–14), 1300–1305. doi: 10.3109/02699052.2011.624571

Menon, D.K., Schwab, K., Wright, D.W., Maas, A., & The Demographics and Clinical Assessment Working Group of the International and Interagency Initiative toward Common Data Elements for Research on Traumatic Brain Injury and Psychological Health. (2010). Position statement: Definition of traumatic brain injury. *Archives of Physical Medicine & Rehabilitation*, *91*(11), 1637–1640.

Mittenberg, W., DiGuilio, D., Perrin, S., & Bass, A. (1992). Symptoms following mild head injury: Expectation as aetiology. *Journal of Neurology, Neurosurgery, and Psychiatry*, *55*, 200–204.

Nolin, P., Villemure, R., & Heroux, L. (2006). Determining long-term symptoms following mild traumatic brain injury: Method of interview affects self-report. *Brain Injury*, *20*(11), 1147–1154. doi: 10.1080/02699050601049247

Nordgaard, J., Revsbech, R., Sæbye, D., & Parnas, J. (2012). Assessing the diagnostic validity of a structured psychiatric interview in a first-admission hospital sample. *World Psychiatry*, *11,* 181–185.

Ryan, L.M., & Warden, D.L. (2003). Post concussion syndrome. *International Review of Psychiatry*, *15*, 310–316.

Sigurdardottir, S., Andelic, N., Roe, C., Jerstad, T., & Schanke, A., (2009) Post-concussion symptoms after traumatic brain injury at 3 and 12 months postinjury: A prospective study. *Brain Injury*, *23*(6), 489–497. doi: 10.1080/02699050902926309

Stapleton, E., & Mills, R. (2008). Role of open-ended questionnaires in patients with balance symptoms. *Journal of Laryngology & Otology*, *122*, 139–144.

Villemure, R., Nolin, P., & Le Sage, N. (2011). Self-reported symptoms during post-mild traumatic brain injury in acute phase: Influence of interviewing method. *Brain Injury*, *25*(1), 53–64.

Wilkinson, G.S., & Robertson, G.J. (2006). *Wide range achievement test (WRAT4)*. Lutz, FL: Psychological Assessment Resources.

Wood, R.L. (2004). Understanding the 'miserable minority': A diathesis-stress paradigm for post-concussional syndrome. *Brain Injury*, *18*(11), 1135–1153. doi: 10.1080/02699050410001675906

Zimmerman, M. (2003). What should the standard of care for psychiatric diagnostic evaluations be? *The Journal of Nervous and Mental Disease*, *191*, 281–286.