Original Articles

The Post Concussion Symptom Experience and Quality of Life in Indonesian Persons With Mild Traumatic Brain Injury

Fikriyanti* Luppana Kitrungrote** Praneed Songwathana***

Abstract

Background: *Mild Traumatic Brain Injury (mTBI) is the most common type in cases of TBI. Up to 50% of patients experience post concussion symptoms (PCS) after mTBI, which impairs their quality of life (QoL). Despite the high prevalence, existing studies on PCS and QoL of Indonesian persons with mTBI are limited.*

Objectives: *To identify the PCS experience, the QoL level of persons with mTBI, and the correlation between PCS severity and QoL.*

Methods: *One hundred persons with mTBI were recruited from one referral hospital in Aceh province. Questionnaires consisted of three parts: 1) Demographic and Health-related Data Form, 2) the Rivermead Post Concussion Symptoms Questionnaire (RPQ), and 3) the Quality of Life after Brain Injury Overall Scale (QOLIBRI-OS). The contents of these questionnaires were validated by three experts. The intra-class correlation coefficient of RPQ and the internal consistency reliability coefficient of QOLIBRI-OS yielded values of 0.90 and 0.91 respectively. Descriptive statistics and Pearson's correlation analysis were used.*

Results: *Within 2-60 weeks after mTBI, the average symptoms persons experienced were seven (M = 6.7, SD = 3.17). The frequency of symptoms were occurred sometimes (M = 2.37, SD = 0.50) with a low severe level (M = 1.03, SD = 0.51). The top five symptoms*

* Student in Master of Nursing Science (International Program), Faculty of Nursing, Prince of Songkla University, Songkhla, Thailand.

** Assistant Professor, Department of Surgical Nursing, Faculty of Nursing, Prince of Songkla University, Songkhla, Thailand.

*** Associate Professor, Department of Surgical Nursing, Faculty of Nursing, Prince of Songkla University, Songkhla, Thailand.

commonly found were dizziness, headache, fatigue, forgetfulness and taking longer to think, respectively. Regarding the severe level of PCS, hearing disturbance (M = 1.56, SD = 0.53) and blurred vision (M = 1.49, SD = 0.85) were ranked as the first and the second respectively. Overall, the mean scores of total and each item of QoL were at a moderate level. The PCS severity was significant negatively related to QoL (r = - 0.33, p < 0.01).

Conclusion: *PCS could occur at the stage initial and become beyond years post mTBI. Health care providers should increase strategies to reduce PCS severity to improve the QoL of Indonesian persons with mTBI over the short and long term periods.*

Keywords: mild traumatic brain injury; concussion; symptom; quality of life

Background

Mild traumatic brain injury (mTBI) has the highest number of incidence in TBI, namely, at least 80% of all TBI cases (Faul, Xu, Wald, & Coronado, 2010). Although it is not a life threatening condition as moderate or severe TBI, mTBI causes the development of post concussion symptoms (PCS) which has accounted of up to 50% even one year post injury (Fourtassi et al., 2011).

The PCS has been reported as displaying various symptoms including physical, cognitive and affective problems, such as headache, dizziness, fatigue, sleep disturbance, forgetfulness, irritability and anxiety (Bergman, 2011; Lannsjo, Geijerstam, Johansson, Bring, & Borg, 2009). PCS could occur on the first day and in the following weeks (Paniak et al., 2002), and is usually resolved within three months after injury (Lannsjo et al., 2009; Yang, Hua, Tu, & Huang, 2009). However, in some cases, PCS may cause considerable problems after 3 months up to 10 years (King & Kirwilliam, 2011; Roe, Sveen, Alvsaker, & Bautz-Houlter, 2009; Sigurdardottir, Andelic, Roe, Jerstad, & Schanke, 2009). PCS experience could lead persons to be disabled and unfit to in return to work (Boake et al., 2005) and affect their quality of life (QoL) (Fourtassi et al., 2011).

Previous researchers examined the QoL of persons within 1 month to 10 years post mTBI. The different levels of QoL were reported (Beseoglu, Roussaint, Steiger, & Hanggi, 2012; Fourtassi et al., 2011; Zhang, Carroll, Cassidy, & Paniak, 2009; Zumstein et al., 2011). More than two-third of the patients (70.8%) had poor to fair QoL in the first three months after mTBI (Zhang et al., 2009). Three studies reported moderate to high QoL in the long-term period of 1 to 10 years after mTBI (Beseoglu et al., 2012; Fourtassi et al., 2011; Zumstein et al., 2011). Regarding each domain of the QoL, the physical domain was found

to be lower than the domains of emotional, cognition, social and function (Beseoglu et al., 2012). Overall, the QoL had a negative correlation with the PCS severity (King & Kirwilliam, 2011).

According to the Symptom Management Model (SMM) of Dodd et al. (2001), the dimensions of symptom experience, symptom management and outcomes (e.g., QoL) involve a dynamic process. These dimensions are interrelated and influenced by three factors including person, health and illness, and environment. PCS experience and QoL of persons with mTBI have been studied in the western countries. However, these findings may not be fully applicable to Eastern countries, such as Indonesia, because certain factors of Western countries and Indonesia differ, such as personal belief, health care services, and socio-cultural aspects. These differences could possibly make Indonesian persons with mTBI perceive and manage their PCS differently resulting in different QoL levels. In addition, the existing studies of PCS and QoL on Indonesian persons with mTBI have been limited. So, such a study would be significant in providing the critical baseline data for developing nursing practice related to PCS experience and QoL in persons with mTBI, particularly in Indonesia. Therefore, conducting this study to identify the PCS experience, QoL level, and the relationship between PCS severity and QoL of Indonesian persons with mTBI was considered to be important.

Objectives

The objectives of this study were to 1) identify the PCS experience of the Indonesian persons with mTBI, 2) determine the level of QoL of the Indonesian persons with mTBI, and 3) examine the relationship between the PCS severity and QoL.

Conceptual Framework

The SMM of Dodd et al. (2001) was used to guide this study. The SMM has three dimensions composed of the symptom experience, symptom management strategies, and outcomes. The three dimensions have an interactional relationship with each other, and correlate with three factors including person, health and illness, and environment.

In this study, the differences and relationship between the dimensions of symptom experience and outcomes were explored. Symptom experience refers to a person's perception and evaluation of the occurrence, frequency and severity of PCS. QoL was defined as the variable of the outcomes. In this study, the QoL questionnaire indicated the level of satisfaction in the following areas: 1) physical condition, 2) cognition, 3) emotions, 4) function in daily life, 5) personal and social life, and 6) current situation and future prospects (von Steinbuechel, Richter, Morawetz, & Riemsma, 2005).

Methods

A cross-sectional correlation study

was designed. The persons with mTBI were recruited from one referral hospital in Banda Aceh city, Aceh province in Indonesia. The selection was based on the following inclusion criteria: 1) age from 18 to 65 years old, 2) diagnosed with mTBI with the Glasgow Coma Score (GCS) of 13-15, 3) had post mild head injury for at least two weeks, 4) had no psychiatric illness, neurological disorders, and 5) be able to understand Indonesian and the local language.

The estimated sample size was calculated using power analysis at a level of significance of 0.05, and expected power of 0.80. The effect size was estimated based on the previous study by Kliangda (2009) who conducted a survey of 88 Thai persons with mTBI. The significant negative correlation between headache experience and Qol was found (Pearson's $r = -0.56$, $p < 0.01$). Based on Polit and Beck (2008), the sample size in this study was 32. However, the researchers increased the number of sample from 32 to 100 to examine the 17 items (more than headache symptom) in the Rivermead Post-concussion Symptoms Questionnaire.

Instruments

Three questionnaires were used: 1) Demographic and Health-related Data Form, 2) the Rivermead Post Concussion Symptoms (King, Crawford, Wenden, Moss, & Wade, 1995), and 3) The Quality of Life after Brain Injury Overall Scale (von Steinbuechel et al., 2012).

1. Demographic and Health-related Data Form. This form was developed by the researchers based on literature review. It is composed of age, gender, religion, marital status, educational level, occupation, family income, living arrangements, period post mTBI, the causes of mTBI, type of brain injury, injury-related variables (i.e., GCS, confusion, loss of consciousness [LOC] for 30 minutes or less, amnesia for less than 24 hours, others [neurological abnormalities], location of brain injury, and additional injuries).

2. The Rivermead Post-concussion Symptoms Questionnaire (RPQ). The RPQ consists of 16 symptoms and the open-ended question for an additional answer. For each symptom, it was assessed the PCS occurrence by using "yes/ no" checklist, if the subject chooses "yes", then the frequency and severity of PCS are further measured on the Likert scale. The frequency was in the range of 1 (rarely) to 4 (most times), and severity of PCS was in the range 0 (not severe) to 4 (very severe). For data interpretation, the means of the frequency score were categorized into three levels as follows: few (1.00 - 2.00), sometimes (2.01 - 3.00), and most times (3.01 - 4.00). The means of the severity score were categorized into three levels as follows: low (0 - 1.33), moderate (1.34 - 2.66), and high (2.67 - 4.00).

3. The Quality of Life after Brain Injury Overall Scale (QOLIBRI-OS). The QOLIBRI-OS was composed of six items

including: 1) physical condition, 2) cognition, 3) emotions, 4) function in daily life, 5) personal and social life, and 6) current situation and future prospects. It was measured by using a 5 point-Likert scale in range 1 (not satisfied at all) to 5 (very satisfied). The total score was then calculated. Following that, the score was interpreted by using the mean. The QoL score was categorized as being at a low level if the score was less than mean − 1 SD, and at a moderate level if the score was in the range mean ± 1 SD, and a high level if the score was higher than mean + 1 SD (Polit & Beck, 2008, p.388).

The qualities of the questionnaires were evaluated by using the content validation, translation processes, and reliability test. The stability of the RPQ was analyzed by using intra-class correlation coefficient, yielding the value of 0.90. The internal consistency reliability of QOLIBRI-OS was tested and its Cronbach's alpha coefficient was 0.91.

Data Collection

Data collection was conducted from December 2012 to March 2013 after this research was approved by the Research Ethic Committee of Faculty of Nursing, Prince of Songkla University, Thailand, and the Director of referral hospital in Aceh province, Indonesia. The first author introduced herself to the head of the emergency unit, of the In-patients Department and of the medical record unit to obtain informed consent. The medical records of the subjects who met the inclusion criteria from those units were reviewed. After that the subjects were informed of the objectives their rights. They could withdraw from the study at any time that did not have any effect on their medical treatment. The subjects' information was kept confidentially. After the subjects were given a verbal consent, they were interviewed via telephone by the first author. The questionnaire took about 15-20 minutes to be completed.

Data Analysis

The descriptive statistic was used to analyze demographic and health-related data, PCS experience and QoL. Median (Mdn) and interquartile range (IQR) of demographic and health-related data were reported. In addition, the PCS severity scores and QoL scores were normally distributed and met the linearity assumption. Therefore, Pearson correlation coefficient was used to examine the relationship between the PCS severity and QoL.

Results

Demographic and health-related data

One hundred subjects with mTBI were young Muslim adults with the median age of 26 years old (IQR = 20, range = 18 - 65). Fifty-four percent of the subjects were male. A half of them had college education level (50%). Over half of the subjects were workers (54%), followed by students (29%). Nearly half the subjects

were single (49%) and the majority of them have lived with their family (81%). Regarding health illness, they had previous mTBI with the median of 13 weeks (IQR = 24, range = 2 - 60). The major cause of brain injury was from motorcycle accident (89%). Most of the subjects had loss of consciousness less than or equal 30 minutes after injury (74%). Their GCS at an emergency department was 15 (74%). The sites of head injury were mostly found at temporal (47%) and frontal sites (41%). One-third of the subjects reported other organ injuries (35%) (e.g., skin laceration, dislocation or fracture of extremities) (Table 1).

Table 1 Frequency, percentage, median (Mdn), interquartile range (IQR), and range of the subjects classified by demographic and health-related data (N = 100)

Characteristics	n	%
Age (year) (Mdn = 26, IQR = 20, range =18-65)		
18 - 30	60	60
31 - 40	15	15
41 - 65	25	25
Gender		
Male	54	54
Female	46	46
Religion		
Islam	100	100
Marital status		
Single	49	49
Married	45	45
Widowed	6	6
Education level		
Primary school	1	1
High school	49	49
College	50	50
Occupation		
Workers (i.e. employee, government officer, agricultural worker, businessman)	54	54
Student	29	29
Housewife	17	17
Family income (Rp)* (Rp* 9,690 = 1USD)		
<1,350,000	20	20
1,350,000 – 2,500,000	66	66
> 2,500,000	14	14
Period post mTBI (week), Mdn = 13, IQR = 24, range = 2 - 60)		
2 - 12	49	49
13 - 60	51	51
Causes of mTBI		
Motorcycle accident	89	89
Fall	8	8
Sport injury / assault	3	3
Type of head injury		
Laceration	54	54
Swelling	46	46
Injury-related factors at ED		
GCS		
15	74	74
14	13	13
13	13	13
Confusion	66	66
LOC ≤30 minutes after injury	74	74
Amnesia < 24 hours	39	39
Other neurological abnormalities (i.e. seizure, hemotympanum)	15	15
Sites of brain injury		
Temporal	47	47
Frontal	41	41
Occipital	6	6
Parietal	4	4

Table 1 (to)

Characteristics	n	%
Living arrangement		
With family	81	81
With friend	13	13
Alone	6	6
Undefined location	2	2
Additional injuries (i.e. skin laceration, joints dislocation, bone fracture, chest trauma)	35	35

Post concussion symptom experience of persons with mild traumatic brain injury

Overall, the persons with mTBI had 17 symptoms over the past 2 - 60 weeks. They experienced on average seven symptoms (M = 6.7, SD = 3.17), with a sometimes frequency (M = 2.37, SD = 0.50) and a low severe level (M = 1.03, SD = 0.51). Dizziness was the first range of PCS occurrence, followed by headache, fatigue, forgetfulness, and taking longer to think. Regarding the severe level of PCS, hearing disturbance (M = 1.56, SD = 0.53) and blurred vision (M = 1.49, SD = 0.85) were ranked as the first and the second, respectively (Table 2).

Table 2 The occurrence, frequency, and severity level of post concussion symptom (N = 100)

Symptoms	Occurrence	Frequency			Severity level			
	n	M (SD)	Skewness value	Kurtosis value	M (SD)	Mdn (IQR)	Skewness value	Kurtosis value
1. Dizziness	78	2.58 (0.83)	-2.21	-0.052	-	1.0 (1.0)	3.30	4.93
2. Headache	76	2.66 (0.76)	-2.36	0.39	-	1.0 (1.0)	5.10	5.40
3. Fatigue	74	2.57 (0.79)	0.39	-0.79	1.20 (0.72)	-	1.25	0.31
4. Forgetfulness	61	2.49 (0.76)	0.09	-0.47	1.15 (0.70)	-	1.24	0.58
5. Taking longer to think	52	2.46 (0.72)	0.90	-0.17	1.19 (0.74)	-	1.73	0.80
6. Sleep disturbance	48	2.40 (0.79)	0.65	-0.36	-	1.0 (0.0)	3.43	4.60
7. Poor concentration	43	2.42 (0.70)	0.23	-0.11	1.16 (0.69)	-	0.66	0.26
8. Restlessness/ anxiety	43	2.19 (0.66)	0.80	0.55	0.95 (0.65)	-	0.12	-0.74
9. Depression	40	2.03 (0.82)	1.26	-0.24	0.80 (0.68)	-	0.53	-0.99
10. Irritability	39	2.31 (0.89)	0.71	-0.73	-	1.0 (1.0)	3.53	3.35
11. Blurred vision	35	3.03 (0.78)	-1.10	-0.23	1.49 (0.85)	-	1.63	1.48
12. Frustration	26	2.15 (0.93)	1.45	-0.10	0.85 (0.73)	-	0.55	-1.13
13. Noise sensitivity	20	2.00 (0.79)	1.37	0.81	0.85 (0.81)	-	1.85	1.19

Table 2 (to)

Symptoms	Occurrence n	Frequency M (SD)	Frequency Skewness value	Frequency Kurtosis value	Severity level M (SD)	Severity level Mdn (IQR)	Severity level Skewness value	Severity level Kurtosis value
14. Nausea and/ or vomiting	12	1.67 (0.65)	0.69	-0.27	0.58 (0.67)	-	1.15	-0.15
15. Light sensitivity	9	2.00 (0.87)	1.70	2.07	0.78 (0.97)	-	1.70	2.07
16. Hearing disturbance	9	3.56 (0.53)	-0.38	-1.84	1.56 (0.53)	-	-0.38	-1.84
17. Double vision	6	2.00 (1.26)	1.05	-0.45	1.17 (1.17)	-	0.79	-0.26

Quality of life of persons with mild traumatic brain injury

The overall mean scores and each item of QoL in persons with mTBI were at a moderate level. Regarding to each item, it was found that the highest mean score was personal and social life (M = 3.99, SD = 0.84), and the lowest mean score was physical condition (M = 3.38, SD = 0.94) (Table 3).

Table 3 Mean, standard deviation, skewness values, kurtosis values, and levels of Quality of Life (N =100)

Item	M (SD)	Skewness value	Kurtosis value	Level
1. Physical condition	3.38 (0.94)	-1.30	0.49	Moderate
2. Cognition	3.50 (0.87)	0.97	-1.34	Moderate
3. Emotions	3.64 (0.85)	-0.84	0.86	Moderate
4. Function in daily life	3.79 (1.02)	-3.06	1.40	Moderate
5. Personal and social life	3.99 (0.84)	-1.61	-0.27	Moderate
6. Current situation and future prospects	3.74 (0.93)	-0.63	-1.12	Moderate
Total QoL	3.67 (0.75)	0.22	-0.77	Moderate

The relationship between post concussion symptom severity and quality of life

Relationship between PCS severity and QoL was examined by Pearson correlation statistic. The result showed that PCS severity had significantly negative correlation to QoL ($r = -0.33$, $p < 0.01$).

Discussion

The Indonesian persons with mTBI in this study were more likely male than female at the age of a worker. The major cause of mTBI was a motorcycle accident. This age group may be at high risk of accident that similar to most developing countries, working people in urban areas

(e.g., Banda Aceh city in Aceh province, Indonesia) use motorcycles for transportation because it is regarded as inexpensive; convenient; and fast, resulting in the frequent cause of accident and injuries. The findings of this study were similar to Kliangda (2009). Most of subjects had GCS at 15 and loss of consciousness less than 30 minutes of the initial event which was commonly found in mTBI.

Post concussion symptom experience in persons with mild traumatic brain injury

The Indonesian persons have usually experienced a total of 17 PCS within 13 weeks post mTBI. This finding was similar to the previous studies (Bergman, 2011; Lannsjo et al., 2009; Ponsford, Cameron, Fitzgerald, & Mikocka-Walus, 2011) who found that PCS occurred early in onset and short in duration, but some persons may experience these symptoms for years after mTBI. The PCS experience was caused from several factors relating to the SMM of Dodd et al. (2001). These included health and illness (e.g., head trauma, location injury, and concomitant symptoms), person (working status post injury), and environment (lack of health information about PCS management).

Due to PCS experience, the persons had neuropathology relating to swift acceleration and deceleration of force caused by mTBI, which damages structure and metabolic of brain (Alexander, 1995; Barkhoudarian, Hovda, & Giza, 2011). The structure of neuropathology in mTBI or diffused axonal injury occurred from the fragile structures of axons and small vessels leading to selling and lysis of axon and producing hemorrhages (Len & Neary, 2011; Werner & Engelhard, 2007). Moreover, the neurometabolic cascade includes alteration of neurotransmitter hormone function and electrolyte fluctuations at the cellular level. Consequently, the cerebral autoregulation was interrupted (Prigatano & Gale, 2011) and the brain's normal metabolic functions were altered for days to weeks following the injury (McCrea, 2008).

The sites of brain injury also contributed to some PCS experiences. For example, temporal area injury may cause the damage to peripheral vestibular function (Defense Centers of Excellence [DCoE], 2010), the memory, and processing input and storing of the data (Gould & Dyer, 2011). This evidence was found in this study, which showed that the subjects commonly suffered from dizziness, forgetfulness, and taking longer to think. Moreover, injury at the temporal area possibly related to skull trauma and caused some subjects in this study to have hemotympanum at ED admission or developing hearing disturbance at a later times (Begemalm, 2003; Munjal, Panda, & Pathak, 2010). Injury to the occipital area also may damage the optic tract and contribute to blurred vision in some subjects (Greenwald, Kapoor, & Singh, 2012).

Besides the neuropathology and sites

of brain injury, symptoms-associated factors, personal and environmental factors possibly developed other PCS occurrences and increased PCS frequency and severity. Previous studies reported that headaches and visual system deficiencies were associated with dizziness (DCoE, 2010). The sleep complaint at 10 days was associated with headache (Chaput, Gigùre, Chauny, Denis, & Lavigne, 2009). Headache and sleep disturbance were contributed to fatigue, reporting more PCS and high level of PCS severity which would have the great affect to develop more fatigue (DCoE, 2010; Ponsford et al. 2011). Moreover, blurred vision may occur frequently with other symptoms related to vestibular and cognitive problems such as dizziness, headache, and memory loss (Greenwald et al., 2012).

Obviously, although the overall persons with mTBI evaluated their PCS with sometimes frequency and a low severe level, half of them have had persistent PCS and some reported the high score of severity (e.g., hearing disturbance and blurred vision). These situations possibly explained that the subjects were recruited from one referral hospital without a follow up by healthcare providers, and they ignored emergency department/ clinic instructions (e.g., warning signs and symptoms to go to the hospital/ the physician). Therefore, no further healthcare providers' assistance for PCS management was provided. Moreover, the majority of subjects in this study were at a working age, who attempted or were expected to return to work or school post mTBI. This personal characteristics may contribute to the severity of PCS because the task in the workplace or school may affect the function of the brain or sensorimotor vision and auditory before complete recovery post injury (Department of Veterans Affairs, Department of Defense [VA/DoD], 2009; Greenwald et al., 2012). In addition, without health care follow up, the persons with mTBI possibly were struggling to manage PCS by themselves and lacked in PCS relief effectiveness. Consequently, they experienced persistent and severe PCS, similar to the studies by Fourtassi et al. (2011), Greenwald et al. (2012), and Munjal et al. (2010).

Quality of life of patients with mild traumatic brain injury

Overall, QoL of the study subjects was at a moderate level. The highest score item was the personal and social life. The lowest score item was physical condition. Physical condition had the lowest score and it may be because the physical problems of PCS were mostly found in this study. These physical symptoms were dizziness, headache, fatigue, sleep disturbance, and hearing and vision disturbances which could alter their daily activities (e.g., working, studying, or driving). Although the frequency and severity of physical problems was not at a high level, the chronic symptoms occurrence of most subjects may negatively impact on patients regarding effective physical functioning and productivity. This finding was supported by Beseouglu et al. (2012)

who showed that the persons who did not fully recover from physical problems after injury would have reduced satisfaction with their health.

However, the item of personal and social life was rated as high. This may be because of some reasons. Firstly, from a young adult's perspective, a return to work after mTBI may be shown as a valued long term indicator of QoL (Rufflo, Friedland, Dawson, Colantonio, & Lindsay, 1999). Employment is important, not only for earning a livelihood, but for determining access to health care, social support system, and self-esteem. In addition, a return to work is associated with improved health, well-being, social integration and QoL. Secondly, living with their family and friends for social support may help the subjects in this study cope and manage with their PCS with similar to a study of Fithria (2009). Thirdly, the faith of Islamic teaching could make the subjects cope emotionally when faced with acute conditions or long-term problems. Consistent with a previous study, most persons with mTBI (85%) had moderate satisfaction after using religious therapy (Gau, Yang, Huang, & Lou, 2012).

The relationship between post concussion symptom severity and quality of life

The PCS severity had significantly negative relationship with QoL reflecting that the persons who have higher severe level of PCS would report a lower QoL. This finding is supported by the SMM (Dodd et al., 2001), which suggests that there is relationship between symptom experience (e.g., PCS severity) and outcomes (e.g., QoL). When persons in this study had a relatively high functional level pre-injury, there was limitation in performing physical activities resulting from severe physical problems of PCS post mTBI (e.g., hearing disturbance and blurred vision). With this regard, they reported a low QoL. This result was consistent with the study by King and Kirwilliam (2011) who found that the PCS severity reduced an individual's capacity to work.

Although this study was primarily conducted in Aceh province Indonesia, limitation should be considered in terms of generalization. Because one referral hospital was used for data collection which located in western Indonesia, this may not be comparable to the other large cities, such as Jakarta.

Implications

PCS of Indonesian persons occurred within weeks to months post mTBI. Overall, they have experienced on average seven PCS. Physical and cognitive symptoms were commonly occurred, with a sometimes frequency. Regarding to the severity of PCS, hearing disturbance and blurred vision were ranked as first and second, respectively. In addition, the severity of PCS negatively related to the QoL level, which was consistent with the SMM (Dodd et al., 2001). Therefore, to improve QoL, healthcare providers should reduce PCS severity by providing health

information about PCS management, and regularly following up in the acute and rehabilitation phases. Future research is recommended to investigate factors of QoL in persons with mTBI, such as physical functioning, religious coping, and family support. A replication study extends to other settings should be conducted.

References

Alexander, M. P. (1995). Mild traumatic brain injury: Pathophysiology, natural history, and clinical management. *Neurology, 45*, 1253 - 1260.

Barkhoudarian, G., Hovda, A. D, & Giza, C. C. (2011). The molecular pathophysiology of concussive brain injury. *Clinic Sport in Medicine, 30*, 33 - 48.

Bergemalm, P. O. (2003). Progressive hearing loss after closed head injury: A predictable outcome? *Acta Otolaryngologica, 123*, 836 - 845.

Bergman, K. S. (2011). *Symptom self-management for mild traumatic brain injury* (Doctoral dissertation). Available from ProQuest Dissertation and Theses database. (UMI No. 3489662).

Beseoglu, K., Roussaint, N., Steiger, H. J., & Hanggi, D. (2013). Quality of life and socio-professional reintegration after mild traumatic brain injury. *British Journal of Neurosurgery, 27*, 202 - 206. doi:10.3109/02688697.2012.717984

Boake, C., McCauley, S. R., Pedroza, C., Levin, H., Brown, S. A., & Brundage, S. I. (2005). Lost productive work time after mild to moderate traumatic brain injury with and without hospitalization. *Neurosurgery, 56*, 994 - 1003. doi:10.1227/01.NEU.0000158319.38230.C3

Chaput, G., Giguère, J. F., Chauny, J. M., Denis, R., & Lavigne, G. (2009). Relationship among subjective sleep complaints, headaches, and mood alterations following a mild traumatic brain injury. *Sleep Medicine, 10,* 713 - 716.

Defense Centers of Excellence [DCoE]. (2010). *Case management of concussion/mild TBI: Guideline document.* Retrieved from http://www.dcoe.health.mil/Content/navigation/documents/Case%20Management%20Of%20Concussion%20Mild%20TBI.pdf

Department of Veterans Affairs, Department of Defense [VA/DoD]. (2009). *VA/DoD clinical practice guideline for management of concussion/mild traumatic brain injury/mTBI* (Versions 1.0). Retrieved from http://www.healthquality.va.gov/mtbi/concussion_mtbi_full_1_0.pdf

Dodd, M., Janson, S., Facione, N., Faucett, J., Froelicher, S. E., Humphreys, J., ... Taylor, D. (2001). Advancing the science of symptom management. *Journal of Advanced Nursing, 33,* 668 - 676.

Faul, M., Xu, L., Wald, M. M., & Coronado, V. G. (2010). *Traumatic brain injury in the United States: Emergency department visits, hospitalizations, and deaths 2002-2006.* Retrieved from http://www.cdc.gov/traumaticbraininjury/pdf/blue_book.pdf

Fithria. (2009). *Family support and psychological well being among the tsunami survivors in Aceh Besar district, Indonesia* (Unpublished master thesis). Faculty of Nursing, Prince of Songkla University, Thailand.

Fourtassi, M., Hajjioui, A., El Ouahabi, A., Benmassaoud, H., Hajjaj-Hassouni, N., & El Khamlichi, A. (2011). Long term outcome following mild traumatic brain injury in Moroccan patients. *Clinical Neurology and Neurosurgery, 113*, 716 - 720. doi: 10.1016/j.clineuro.2011.07.010

Gau, B. S., Yang, H. L., Huang, S. J., & Lou, M. F. (2012). The use of complementary and alternative medicine for patients with traumatic brain injury in Taiwan. *Complementary Alternative Medicine, 12*, 211 – 216. doi:10.1186/1472-6882-12-211

King, N. S., Crawford, S., Wenden, F. J., Moss, M. E., & Wade, D. T. (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.

King, N. S., & Kirwilliam, S. (2011). *Permanent post-concussion symptoms after mild head injury.* Brain Injury, 25, 462 - 470. doi:10.3109/02699052.2011.558042

Kliangda, R. (2009). *Experience of headache, management strategies and health related quality of life in patients with mild traumatic brain injury.* (Unpublished master thesis). Faculty of Nursing, Mahidol University, Thailand.

Landre, N., Poppe, C. J., Davis, N., Schmaus, B., & Hobbs, S. E. (2006). Cognitive functioning and post concussive symptoms in trauma patients with and without mild TBI. *Archives of Clinical Neuropsychology, 21*, 255 - 273. doi:10.1016/j.acn.2005.12.007

Lannsjo, M., AfGeijerstam, J. L., Johansson, U., Bring, J., & Borg, J. (2009). Prevalence and structure of symptoms at 3 months after mild traumatic brain injury in a national cohort. *Brain Injury, 23*, 213 - 219. doi:10.1080/02699050902748356

Len, K. T., & Neary, P. J. (2011). Cerebrovascular pathophysiology follow-

ing mild traumatic brain injury. *Scandinavian Society of Clinical Physiology and Nuclear Medicine, 31*, 85 - 93. doi:10.1111/j.1475-097X.2010.00990.x

McCrea, M. A. (2008). *Mild traumatic brain injury and post concussion syndrome.* Oxford: Oxford Press.

Munjal, S. K., Panda, N. K., & Pathak, A. (2010). Relationship between severity of traumatic brain injury and extent of auditory dysfunction. *Brain Injury, 24*, 525 - 532.

Paniak, C., Reynolds, S., Philips, K., Toller-Lobe, G., Melnyk, A., & Nagy, J. (2002). Patient complaints within 1 month of mild traumatic brain injury: A controlled study. *Archives of Clinical Neuropsychology, 17*, 319 - 334.

Polit, D. F., & Beck, C. T. (2008). *Nursing research: Generating and assessing evidence for nursing practice* (8th ed.). Philadelphia: Lippincott Williams & Wilkins.

Ponsford, J., Cameron, P., Fitzgerald, M., Grant, M., & Mikocka-Walus, A. (2011). Long-term outcomes after uncomplicated mild traumatic brain injury: A comparison with trauma controls. *Journal of Neurotrauma, 28*, 937 - 946.

Prigatano, G. P., & Gale, S. D. (2011). The current status of post concussion syndrome. *Current Opinion in Psychiatry, 24*, 243 - 250. doi:10.1097/YCO.0b013e328344698b

Roe, C., Sveen, U., Alvsaker, K., & Bautz-Holter, E. (2009). Post-concussion symptoms after mild traumatic brain injury: Influence of demographic factors and injury severity in a 1-year cohort study. *Disability and Rehabilitation, 31*, 1235 - 1243.

Sigurdardottir, S., Andelig, N., Roe, C., Jerstad, T., & Schanke, A. (2009). Post-concussion symptoms after traumatic brain injury at 3 and 12 month post-injury: A prospective study. *Brain Injury, 23*, 489 - 497.

Von Steinbuechel, N., Richter, S., Morawetz, C., & Riemsma, R. (2005). Assessment of subjective health and health-related quality of life in persons with acquired or degenerative brain injury. *Current Opinion in Neurology, 18,* 681 - 691.

Von Steinbuechel, N., Wilson, L., Gibbons, H., Muehlan, H., Schmidt, H., Schmidt., ... Truelle, J. (2012). QOLIBRI overall scale: A brief index of health-related quality of life after traumatic brain injury. *The Journal of Neurology, Neurosurgery, and Psychiatry.* doi:10.1136/jnnp-2012-302361

Werner, C., & Engelhard, K. (2007). Pathophysiology of traumatic brain injury. *British Journal of Anaesthesia, 99,* 4 - 9. doi:10.1093/bja/aem131

Yang, C., Hua, M., Tu, Y., & Huang, S. (2009). Early clinical characteristic

of patients with persistent post-concussion symptoms: A prospective study. *Brain Injury, 23*, 299 - 306.

Zhang, S., Carroll, L. J., Cassidy, J. D., & Paniak, C. (2009). Factors influencing self-rated health in traffic-related mild traumatic brain injury. *Journal of Rehabilitation Medicine, 41*, 1062 - 1067. doi:10.1080/02699050902788543

Zumstein, M. A., Moser, M., Mottini, M., Ott, S. R., Sadowski-Cron, Radanov, B. R.,... Exadaktylos, A. (2011). Long-term outcome in patients with mild traumatic brain injury: A prospective observational study. *Journal of Trauma, 71*, 120 - 127.