ผลกระทบที่เกี่ยวข้องกับสุขภาพของการบาดเจ็บที่สมอง: การทบทวนขอบเขต

Health-related Consequences of Traumatic Brain Injury: A Scoping Review

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บทคัดย่อ

การบาดเจ็บที่สมองเป็นปัญหาด้านสาธารณสุขระดับโลก ที่ก่อให้เกิดภาระด้านสุขภาพและเศรษฐกิจอย่างมหาศาล บทความนี้มีวัตถุประสงค์เพื่อทบทวนงานวิจัยที่เกี่ยวข้องกับผลกระทบของการบาดเจ็บทางสมอง ต่อสุขภาพด้านต่างๆของบุคคลที่ได้รับบาดเจ็บทางสมองในทุกระดับความรุนแรงและระยะของการบาดเจ็บ เพื่อนำไปใช้เป็นแนวทางในการพัฒนาคุณภาพการดูแลและศึกษาวิจัยในผู้ป่วยกลุ่มนี้ บทความนี้ได้มาจากการสังเคราะห์งานวิจัยที่ตรงตามเกณฑ์การคัดเลือกจำนวนทั้งสิ้น 24 งานวิจัย ผลการศึกษาพบว่าการบาดเจ็บที่สมองมีผลเสียต่อสุขภาพร่างกาย สติปัญญาการรับรู้ จิตสังคม และพฤติกรรมของบุคคลที่ได้รับบาดเจ็บ การศึกษาทบทวนนี้ยังพบว่าการบาดเจ็บที่สมองซ้ำจะทำให้ผลกระทบของการบาดเจ็บที่สมองมีความซับซ้อนมากขึ้นและอาจทำให้กระบวนการหายของสมองที่ได้รับบาดเจ็บมีความล่าช้า จึงควรให้ความสำคัญมากขึ้นในการป้องกันการบาดเจ็บที่สมองซ้ำ โปรแกรมหรือกลยุทธ์ที่สนับสนุนผู้ที่มีการบาดเจ็บที่สมองในการจัดการกับความปัญหาและผลกระทบที่ตามมาเหล่านี้จึงเป็นสิ่งจำเป็นอย่างยิ่ง สำหรับการวิจัยทางการพยาบาล การศึกษา และการปฏิบัติทางคลินิกสำหรับผู้ที่มีการบาดเจ็บที่สมองในอนาคต ควรให้ความสำคัญกับประเด็นในเรื่องการจัดการอาการ การสนับสนุนทางสังคม ทักษะการแก้ปัญหาที่เหมาะสม การมีวิถีทางสุขภาพที่ดี และการป้องกันการบาดเจ็บที่สมองซ้ำ

คำสำคัญ: การบาดเจ็บที่สมอง, ผลกระทบที่เกี่ยวข้องกับสุขภาพ, ผู้ใหญ่

Abstract

Traumatic brain injury (TBI) is a global public health issue, causing tremendous healthcare and economic burden. The purpose of this review is to examine the consequences of TBI on individuals' health across all levels of severity to guide nursing practice and future research. This review looks at the entire continuum of TBI. A total of 24 studies that met the inclusion criteria were included in this review. The results show that TBI had adverse effects on individuals' physical, cognitive, psychosocial, and behavioral health. This review also found that repetitive TBI, which complicates the consequences and delays the brain healing process, is not adequately addressed. Supportive interventions for persons with TBI to deal with these

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challenges after TBI is essential. Symptom management, social support, problem-solving skills, healthy lifestyle interventions, and repetitive injury prevention for TBI patients should be top priorities for nursing research, education, and clinical practice.

Keywords: Traumatic brain injury / Health-related consequences / Adults

Introduction

Traumatic brain injury (TBI) is defined as "alteration of brain function or other evidence of brain pathophysiology caused by an external force"[1]. TBI is classified into mild, moderate, and severe cases[2]. TBI is a global public health issue, causing great healthcare and economic burden. Each year, around 1.7 million U.S. citizens experience TBI. Approximately 25% require hospitalizations, and about 52,000 victims die, accounting for almost one-third of injury-related deaths[3]. The critical injury affected people in all age groups especially adolescent and younger adults who are significant for workforces and economic growth. The estimated total direct and indirect costs of TBI including loss of productivity are over $76 billion a year[3]. A Romanian study found a sizable portion of severely injured individuals die at the injury sites, and about 25% of severe TBI decease within day seven of injury. A significant portion of TBI patients (43%) have a long-term disability and chronic symptoms[4]. Thailand is ranked the second for the most reported car accidents in the world, traumatic brain injury has been reported as the most leading cause of death and disability in traffic accidents[5]. Overall, the negative on economic and public health impact in the literature is clear. However, its direct health-related impact on individuals after TBI requires further investigation. The purpose of this review is to analyze current studies on various aspects of health-related consequences of TBI among adults to guide nursing practice, appropriate interventions, and further research in this field.

Methodology

Search strategy and outcomes

Four key databases: PubMed, CINAHL, MEDLINE, and Cochrane Library were used to identify peer-reviewed primary research. The search terms: "traumatic brain injury" OR "TBI" OR "head injury" AND "effect" OR "impact" OR "consequence" were utilized to identify primary research to answer the research question systematically. The search was intended to target only adult individuals with TBI. Therefore, NOT "Child*" OR Pediatric OR Adolescent were used in the searching process. Additional studies were also manually searched from the relevant journal articles. The review includes only studies written in English published between January 2009 and December 2021. The initial search yielded 355 records. During the screening process from titles and abstracts, 307 items were eliminated using the inclusion and exclusion criteria, remaining 48 items at this stage. After six duplicates were removed, full-text of 42 studies were assessed for eligibility. Additional 17 records that failed to meet the inclusion criteria were excluded, resulting in 20 studies to be reviewed. Two articles were added from hand search, resulting in the total of 22 included studies for this review (See Prisma Flow Diagram in figure 1). Selected studies represent research from 9 countries.

Data extraction and research quality assessment

The data, including study designs, settings, sample sizes, consequences of TBI, and the findings, were extracted using a data extraction form. The criteria developed by the U.S. Agency for Health

Research Quality for reviewing observational/ non-randomized studies were used as a guideline to evaluate the quality of the identified studies[6]. There was a variety of study designs used to investigate the consequences of TBI in the 24 studies included for this review. Most studies used a cross-sectional design (n = 9; 37.5%), followed by a retrospective and prospective approaches (n = 4; 16.67% for each approach). The other studies utilized a longitudinal qualitative, and secondary analysis design (n = 2; 8.33% for each design). Only one study was a case-control study (4.17%). All studies were non-experimental research providing level-three evidence and used sound research methodology and methods. Most of the identified studies (n = 17; 70.83%) included a relatively large sample size (greater than 100). Among these studies, eight studies can be considered having very large sample sizes (greater than 1,000). The largest sample size was 139,254 patients with TBI recruited from a national research database. Seven studies had a small sample size (n < 100) including two qualitative studies.

Results

Overall, the studies focused on various aspects of health effects of TBI and used different measurements for the targeted outcomes. The health-related consequences of TBI can be classified into four dimensions: physical, cognitive, psychological and health behavioral sequels.

The Physical Health Consequences

The most common physical symptoms after the brain injury included headache, fatigue, sleep disturbance, bodily pain, dizziness, tiredness, and nausea.[4,7,8-11] Neurological symptoms reported by the patients included paralysis, spastic disorder, epilepsy, and fine motor deficits[11]. Physical limitations/ disabilities, especially movement and balance were also a critical difficulty experienced by TBI patients.[9,10-14] Several studies reported the impact relative to sensory impairments.[10,11,15]

The mortality rate of TBI was relatively high: almost 6% of severe TBI cases died on the first day of injury and one-fourth of severely injured case deceased within 7 days after injury[16]. The mortality statistics could be even higher when TBI patients developed post-injury complications. That is, individuals with TBI had around 1.5 times higher risk of developing bacterial infections, pneumonia, and septicemia; two times greater possibility of developing deep vein thrombosis (DVT) and pulmonary embolism (PE); three folds higher risks of cellulitis, device-related infection and non-healing wound compared to general patients[17]. In a study with the largest sample size, the top five post-TBI complications were intracerebral hemorrhage (ICH), acute respiratory tract infection (URI), dizziness, constipation, and urinary tract infection (UTI) respectively. Pneumonia, acute respiratory failure, and UTI was the most common complication grouping, increasing the mortality rate. When septicemia was combined with respiratory complications, the risk of death increased to nearly two folds compared to TBI patients without the complications[16]. Patients with TBI also had over ten times higher risk of having an acute ischemic stroke compared to the overall population (2.5% vs. 0.2%)[18].

The Cognitive Health Consequences

The cognitive sequels seem more persistent than other health aspects. Compared to persons without a history of TBI, Patients with TBI had higher risks of having cognitive impairments included poor memory, concentration, and comprehension.[7,9-11,19-20] Some studies reported that brain trauma resulted in speech deficits[11] and slow thinking process.[8,10] Patients with TBI were more likely to have difficulties in learning, orientation, planning and making decisions which significantly affected their daily living.[8-11]

Post-traumatic memory loss was found in more than 50% of TBI patients in different extents.[7]. TBI individuals revealed 3.8 times more self-reported overall cognitive impairments than the non-TBI controls[9]. Cognitive problems persisted years after brain trauma.[7,9,11,20] While physical and emotional symptoms substantially improved at four years after brain injury, cognitive deficits remained when compared to the control counterparts 20. However, a study with relatively small sample size (n = 84) found no significant difference in cognitive functions between military services members with TBI and the controls13. However, this study included only participants with mild TBI who are likely to have less severe and persistent cognitive issues compared to individuals with moderate to severe TBI.

The Psychosocial Health Consequences

The psychosocial effects of TBI gained considerable attention among the research in the studies reviewed as 75% of the studies investigated the impact of TBI on this health aspect. In relation to psychological effects, many investigators found that TBI was associated with post-traumatic stress disorder (PTSD) and depression.[8,10-13,24-26] These studies showed that incidence rates of PTSD and depression were significantly higher than the general population. Persons who had a positive screening test for TBI presented more than 4.5 times risk for PTSD25. TBI individuals also experienced other negative emotional issues such as anxiety[7,8,10,19,] anger or irritation[7,10,19,] and mental fatigue.[27]

Besides, persons with a history of TBI had significantly poorer self-reported overall mental and emotional health compared to those who did not.[9,19] Two studies reported increased risks of potential psychiatric disorders in TBI persons such as panic disorder, social phobia, and agoraphobia and schizophrenia.[4,23] However, when considering only newly diagnosed psychiatric problems, no significant difference in these outcomes was observed between TBI and non-TBI groups[23]. The association remains unclear, necessitating additional studies to explore and explain this point. Within the social dimension, patients with TBI were more likely to be single or divorced, especially for those with a high level of TBI severity.[8,12] Individuals with a history of brain injury also reported having more family problems[19], decreased social functions[14], and less social connections or community participation compared to the controls[20]. A qualitative study also reported fewer social interactions among individuals after having brain trauma.[11]

The Health Behavioral Consequences

Nine out of 24 studies reported on behavioral sequels following TBI. Most of these studies found associations between brain trauma and alcohol misuse[8,10,25] and substance use.[4,8,19,23,28] Individuals with TBI were found to be four folds more likely to have alcohol-related problems such as drunk driving, traffic accidents, participating in violent behaviors and drinking-related health concerns compared to those without TBI[21]. Individuals with TBI also experienced more difficulties controlling their aggressive or violent behaviors compared to those without a history of TBI.[9,19]

Discussion

The results of this review indicated that TBI had adverse effects not only on physical health but also cognitive, psychosocial, and behavioral health. The findings were consistent with the lower perceived health-related quality of life (HRQoL) which reflects overall subjective health conditions among this group.[7,14] This review addressed that the consequences after brain injury were dependent on the severity of TBI and level of disability. That is,

persons with higher severity of TBI reported more physical limitations, mental problems, and social isolation than those with lower TBI severity. Those with more severe disability presented more depressive symptoms than non-TBI controls[13]. Thus, the severity of injury should be taken into consideration when assessing the patients. The findings of this review also pointed out that TBI and its consequences may have intertwining relationships. For instance, TBI increased the risk for depression, and at the same time, depression also led to difficulty performing daily activities which could in turn delay recovery from TBI[24]. Furthermore, sensory impairments resulted from TBI also had a negative impact on functional improvements[29]. Immobility and decreased consciousness and use of invasive monitoring after TBI may partly account for increased possibility of developing additional post-injury complications such as pneumonia and infections.[8,9,16,17] The findings underlined the importance of post-TBI complications prevention. Importantly, various aspects of TBI consequences seemed complicated and may have synergic effects in developing undesirable outcomes. For example, PTSD after TBI could lead to alcohol dependence which then caused relationship conflicts, mental issues and repeated injuries[7]. These combined effects could even worsen functional outcomes.

Some studies in this review reported different health effects following TBI in women and men. Females were likely to report more post-concussion symptoms[7], psychosocial impairments[9] and chronic mental fatigue than males[27]. The rationale explaining the variation remains unclear and requires further research. Importantly, repetitive brain injuries increase mortality and morbidity rates and tended to cause detrimental consequences. We found that multiple injuries increased the likelihood of PTSD[25] and stress reactions after TBI[10]. Thus, gender and injury repetitions are essential components in patient assessment. For psychosocial aspect, there was adequate evidence that TBI resulted in PTSD, depression, and other negative emotions such as anxiety, frustration, anger, and poor self-reported mental health. However, the connections between TBI and severe psychiatric disorders such as schizophrenia, panic and phobia disorders could not be determined based on the available evidence. Our findings indicated that TBI patients were at high risk of social isolation. Lack of social support and interactions were associated with some physical and mental health concerns which may hinder long-term functional improvements[30]. This social consequence should be assessed and promoting social support and connections may be useful for long-term outcomes.

Implications for Nursing Practice and Further Research

1. The health-related consequences of TBI are complicated and multifaceted, signaling the need of multidisciplinary approaches and effective interventions to manage these consequences.

2. Consequences of TBI, especially cognitive and psychosocial aspects, may persist for years after injury, requiring long-term supportive program to improve patients' functions and quality of life. Future research should focus on developing and evaluating evidence-based interventions or supportive programs to reduce consequences of TBI and improve patients' functions and health-related quality of life.

3. Unhealthy behaviors such as binge drinking and substance misuse were common in persons with brain trauma, suggesting problem-solving skills and healthy lifestyle interventions for TBI patients need to be prioritized.

4. Repetitive brain injuries worsen patients' function and delay recovery. Risk factors should be assessed to design proper prevention strategies. Research on effective nursing interventions to prevent

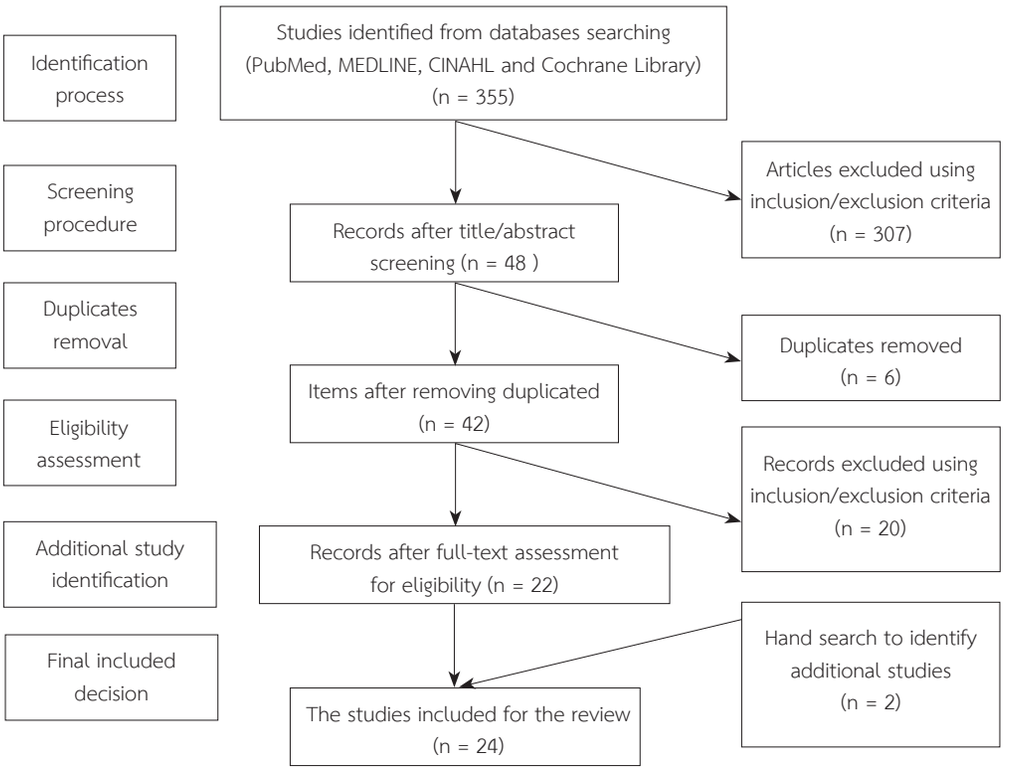
repetitive TBI is needed.

5. TB Iis associated with social isolation and lack of social support which may hinder patients' recovery. Nurses should include this social factor when assessing patients and reinforce connecting with community resources and strengthening social support for optimal outcomes.

Conclusion

TBI resulted in multifaceted health consequences: physical, psychological, cognitive and health behavioral, necessitating early comprehensive assessment and appropriate multidisciplinary approaches to deal with this global-concern injury. The findings in this review revealed that post-concussion symptoms including physical, psychosocial, and cognitive complaints might be persistent for years after injury. Therefore, interventions or strategies to prevent and reduce post-concussion consequences are crucial. Even mild brain injury when occurring repeatedly, can be life-threatening. Social support is essential to promote functional recovery and improve health-related quality of life among TBI survivors. Health-related consequences of TBI are multifaceted, synergically worsening the quality of life of the patients. TBI and its consequences have intertwining relationships, that is, addressing the consequences would positively affect recovery from TBI and vice versa. Repetitive TBI, which complicates the consequences and delays the brain healing process, is not adequately addressed. Supportive interventions for persons with TBI to deal with these challenges after TBI is essential. Symptom management, social support, problem-solving skills, healthy lifestyle interventions, and repetitive injury prevention for TBI patients should be top priorities for nursing research, education, and clinical practice. The limitations of this review lie in its scope including the publication period, the specific language (English only) and the focus on the consequences of TBI in adult patients. Therefore, the application of the findings with caution is recommended.

Figure 1: PRISMA Flow Diagram



References

1. Menon DK, Schwab K, Wright DW, Maas AI, et.al. Position statement: Definition of traumatic brain injury. Archives of Physical Medicine and Rehabilitation. 2010;91(11):1637.
2. Mohamed WRA, Leach MJ, Reda NA, Abd-Ellatif MM, Mohammed MA, Abd-Elaziz MA. The effectiveness of clinical pathway-directed care on hospitalization-related outcomes in patients with severe traumatic brain injury: A quasi-experimental study. Journal of Clinical Nursing. 2018;27(5-6):e820-32.
3. Thaiudom A, Lumnok, N. Development and evaluation of evidence-based nursing protocol for patients with moderate to severe traumatic brain injury. Journal of The Royal Thai Army Nurses. 2018;19(3):107-116. (in Thai)
4. Mittler-Matica R. On traumatic brain injury epidemiological data collected from a county hospital in Romania and an estimation of psychiatric consequences thereof. Romanian Neurosurgery. 2015;22(1):43-50.
5. Phuenpathom N, Srikitwilaikul T, editors. Clinical practice guideline for traumatic brain injury. Bangkok: Thana Press Co., Ltd; 2019. (in Thai)
6. Fink, A. Conducting research literature reviews: From the internet to paper (3rd ed.). California: SAGE Publications; 2009.
7. Ahman S, Saveman B-I, Styrke J, Björnstig U, Stålnacke B-M. Long-term follow-up of patients with mild traumatic brain injury: a mixed-methods study. Journal of Rehabilitation Medicine. 2013(45):758-764.
8. Dams-O'Connor K, Spielman L, Singh A, Gordon WA, Lingsma HF, Maas AI, et al. The impact of previous traumatic brain injury on health and functioning: A TRACK-TBI study. Journal of Neurotrauma. 2013;30(24): 2014-20.
9. Jourdan C, Azouvi P, Genet F, Selly N, Josseran L, Schnitzler A. Disability and health consequences of traumatic brain injury: National prevalence. American Journal of Physical Medicine and Rehabilitation. 2018;97(5):323-31.
10. Petrie EC, Cross DJ, Yarnykh VL, Richards T, Martin NM, Pagulayan K, et al. Neuroimaging, behavioral, and psychological sequelae of repetitive combined blast/impact mild traumatic brain injury in Iraq and Afghanistan war veterans. Journal of Neurotrauma. 2014; 31(5):425-36.
11. Strandberg T, Örebro U, Hälsovetenskapliga I. Adults with acquired traumatic brain injury: Experiences of a changeover process and consequences in everyday life. Social Work in Health Care. 2009;48(3):276-297.
12. Andruszkow H, Urner J, Deniz E, Probst C, Grün O, Lohse R, et al. Subjective impact of traumatic brain injury on long-term outcome at a minimum of 10 years after trauma- first results of a survey on 368 patients from a single academic trauma center in Germany. Patient Safety in Surgery. 2013;7(1):32.
13. MacDonald CL, Johnson AM, Nelson EC, Werner NJ, Fang R, Flaherty SF, et al. Functional status after blast-plus-impact complex concussive traumatic brain injury in evacuated United States military personnel. Journal of Neurotrauma. 2014;31(10):889-898.
14. Mendez MF, Owens EM, Reza Berenji G, Peppers DC, Liang L, Licht EA. Mild traumatic brain injury from primary blast vs. blunt forces: post-concussion consequences and functional neuroimaging. Neuro Rehabilitation. 2013;32(2):397-407.
15. Drummond M, Douglas J, Olver J. 'If I haven't got any smell . I'm out of work': Consequences of olfactory impairment following traumatic brain injury. Brain Injury. 2013;27(3):332-45.
16. Ho CH, Liang FW, Wang JJ, Chio CC, Kuo JR. Impact of grouping complications on mortality in traumatic brain injury: A nationwide population-based study. PLoS One. 2018; 13(1):e0190683.

17. Rauh MJ, Aralis HJ, Melcer T, Macera CA, Sessoms P, Bartlett J, et al. Effect of traumatic brain injury among U.S. servicemembers with amputation. The Journal of Rehabilitation Research and Development. 2013;50(2): 161-172.
18. Kowalski RG, Haarbauer-Krupa JK, Bell JM, Corrigan JD, Hammond FM, Torbey MT, et al. Acute ischemic stroke after moderate to severe traumatic brain injury: Incidence and impact on outcome. Stroke. 2017;48(7):1802-9.
19. Gargaro J, Gerber GJ, Nir P. Brain injury in persons with serious mental illness who have a history of chronic homelessness: Could this impact how services are delivered? Canadian Journal of Community Mental Health. 2016; 35(2):69-77.
20. Theadom A, Starkey N, Barker-Collo S, Jones K, Ameratunga S, Feigin V, et al. Population-based cohort study of the impacts of mild traumatic brain injury in adults four years post-injury. PLoS One. 2018;13(1):e0191655.
21. Adams RS, Larson MJ, Corrigan JD, Ritter GA, Williams TV. Traumatic Brain Injury Among US Active Duty Military Personnel and Negative Drinking-Related Consequences. Substance Use & Misuse. 2013;48(10):821-36.
22. Bombardier CH, Fann JR, Temkin NR, Esselman PC, Barber J, Dikmen SS. Rates of major depressive disorder and clinical outcomes following traumatic brain injury. JAMA. 2010;303(19):1938-45.
23. Bryant RA, O'Donnell ML, Creamer M, Mc Farlane AC, Clark CR, Silove D. The psychiatric sequelae of traumatic brain injury. American Journal of Psychiatry. 2010;167(3):312-20.
24. Haagsma JA, Scholten AC, Andriessen TMJC, Vos PE, Van Beeck EF, Polinder S. Impact of depression and post-traumatic stress disorder on functional outcome and health-related quality of life of patients with mild traumatic brain injury. Journal of Neurotrauma. 2015; 32(11):853-862.
25. Maguen S, Madden E, Lau KM, Seal K. The impact of head injury mechanism on mental health symptoms in veterans: do number and type of exposures matter? Journal of Trauma Stress. 2012;25(1):3-9.
26. Lewis FD, Horn GJ. Depression following traumatic brain injury: Impact on post-hospital residential rehabilitation outcomes. Neuro Rehabilitation. 2017;40(3):401-10.
27. Palm S, Ronnback L, Johansson B. Long-term mental fatigue after traumatic brain injury and impact on employment status. Journal of Rehabilitation Medicine. 2017;49(3):228-33.
28. Devonish JA, Homish DL, Vest BM, Daws RC, Hoopsick RA, Homish GG. The impact of military service and traumatic brain injury on the substance use norms of Army Reserve and National Guard Soldiers and their spouses. Addictive Behaviors. 2017;72:51-6.
29. Lew HL, Garvert DW, Pogoda TK, Hsu P-T, Devine JM, White DK, et al. Auditory and visual impairments in patients with blast-related traumatic brain injury: Effect of dual sensory impairment on functional independence measure. The Journal of Rehabilitation Research and Development. 2009;46(6): 819-826.
30. Umberson D, Karas Montez J. Social Relationships and Health: A Flashpoint for Health Policy. Journal of Health and Social Behavior. 2010;51(1_suppl):S54-S66.