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Caring for Patients with Traumatic Brain Injury: A Survey of Nurses' Perceptions

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Abstract

Aims and objectives—The purpose of this study was to determine nurses' perceptions about caring for patients with traumatic brain injury (TBI).

Background—Annually, it is estimated that over 10 million people sustain a TBI around the world. Patients with TBI and families are often concerned with expectations about recovery and seek information from nurses. Nurses' perceptions of care might influence information provided to patients and families, particularly if inaccurate knowledge and perceptions are held. Thus, nurses must be knowledgeable about care of these patients.

Methods—A cross-sectional survey, the Perceptions of Brain Injury Survey (PBIS), was completed electronically by 513 nurses between October and December 2014. Data were analyzed with structural equation modeling, factor analysis, and pairwise comparisons.

Results—Using latent class analysis, authors were able to divide nurses into three homogeneous sub-groups based on perceived knowledge: low, moderate, and high. Findings showed nurses who care for patients with TBI the most have the highest perceived confidence but the lowest perceived knowledge. Nurses also had significant variations in training.

Conclusions—As there is limited literature on nurses' perceptions of caring for patients with TBI, these findings have implications for training and educating nurses, including direction for development of nursing educational interventions.

Relevance to clinical practice—As the incidence of TBI is growing, it is imperative that nurses be knowledgeable about care of patients with these injuries. The PBIS can be used to determine inaccurate perceptions about caring for patients with TBI before educating and training nurses.

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Conflicts of Interest

The authors declare no conflicts of interest.

Keywords

Traumatic Brain Injuries; Nursing Care; Nursing Attitudes; Nursing Education; Survey Research; Structural Equation Modeling; Latent Class Analysis

Introduction

There is a high incidence of traumatic brain injury (TBI) across the globe, with over 10 million people sustaining a traumatic brain injury (TBI) each year (Hyder, Wunderlich, Puvanachandra, Gururaj, & Kobusingye, 2007). Nurses worldwide, regardless of hospital setting, are likely to see patients with TBI depending on severity of injury, time since injury, and comorbidities (McQuillan & Mitchell, 2002). Nurses play an important role in caring for patients with TBI, as these patients and their families are often concerned with expectations about recovery and seek information from nurses (Long, Kneafsey, Ryan, & Berry, 2002). It's important that nurses have accurate perceptions about care, as their perceptions might influence information provided to patients and families, particularly if inaccurate knowledge and perceptions are held (Grol, 1997). Although the limited available research has revealed gaps in nurses' knowledge and inconsistencies in clinical practice, no literature could be located on nurses' perceptions of training and education to care for patients with cognitive impairments caused by a new TBI or a history of moderate-to-severe TBI.

To determine nurses' perceptions about caring for patients with TBI, a cross-sectional survey, the Perceptions of Brain Injury Survey (PBIS), was completed electronically by 513 nurses between October and December 2014. Our findings show nurses who care for patients with TBI the most have the highest perceived confidence but the lowest perceived knowledge. Nurses also had significant variations in training. These findings have implications for training and educating nurses, including direction for development of nursing educational interventions. The PBIS can be used to determine inaccurate perceptions about caring for patients with TBI before educating and training nurses, which is applicable to nurses around the world.

Background

Traumatic brain injury (TBI) is defined as "a bump, blow or jolt to the head or a penetrating head injury that disrupts the normal function of the brain" (Centers for Disease Control and Prevention, 2014). Globally, over 10 million people are estimated to sustain a TBI on an annual basis; however, estimates of TBI incidence rates worldwide are limited (Hyder et al., 2007). Each year, more than 2.5 million people sustain a TBI in the United States (U.S.) (Centers for Disease Control and Prevention, 2014), and there are currently over 5.3 million people living with chronic disabilities caused by TBI residing in the U.S. (Vanderploeg et al., 2008). Treatment of TBI has great public health significance, as each year, approximately \$76.5 billion is spent on TBI treatment and rehabilitation (Finkelstein, Corso, & Miller, 2006). TBI occurs most in young children between 0 and 4 years, followed by adolescents between 15 and 19 years, and adults age 65 years and older (Faul, Xu, Wald, & Coronado, 2010). Although the incidence of TBI in women is increasing, men have higher rates of TBI than women regardless of age group (Faul et al., 2010). Regardless of sex, over

75% of all cases of TBI are mild (Rao et al., 2010). Although the majority of TBI cases are mild, those who sustain moderate-to-severe injuries endure chronic impairments (Corrigan & Hammond, 2013).

After sustaining a moderate-to-severe TBI, cognitive impairments may include impairments in memory, attention, executive function, and psychomotor and verbal communication skills (Brain Injury Association of America, 2015); deficits causing decreased capacity for new learning and slowed information processing are also typical (Brain Injury Association of America, 2015). These impairments are chronic, often lasting a lifetime and affecting various aspects of the person's life, including learning, employment, and social relationships (Faul et al., 2010). In comparison, cognitive impairments caused by mild TBIs often include emotional distress and poorer physical functioning (e.g., fatigue) (Brain Injury Association of America, 2015). Impairments caused by mild TBI are less severe than those seen in patients with moderate-to-severe TBI. Mild TBI symptoms may be resolved hours, days, or weeks after injury (Brain Injury Association of America, 2012), whereas recovery can take months to years after a moderate-to-severe TBI (Millis et al., 2001). As TBI occurs primarily in younger demographic (Faul et al., 2010), those with moderate-to-severe injuries are likely to live with chronic cognitive impairments over their life span (Corrigan & Hammond, 2013), including when facing other health conditions later in life.

Chronic cognitive impairments are likely to have an influence on the way patients with a history of moderate-to-severe TBI communicate and receive information and education from healthcare providers, including having difficulty with communication, comprehension, and retention of information (Povlishock & Katz, 2005). Presence of cognitive impairments may warrant alterations in the typical care process, such as need for healthcare providers to modify strategies to be able to effectively communicate and educate these patients. In particular, nurses play a large role in educating patients with moderate-to-severe TBI (Long et al., 2002), and will likely need to alter their care plans in accordance with patient difficulties.

Yet, research has revealed gaps in nurses' knowledge and inconsistencies in clinical practice in caring for patients with TBI (Watts, Gibbons, & Kurzweil, 2011). Current literature focuses on management of mild TBI or acute management of patients after moderate-to-severe TBI with limited to no literature focusing on non-acute management of patients with moderate-to-severe TBI. To the authors' knowledge, no literature could be located on nurses' perceptions of training and education to care for patients with cognitive impairments caused by a new moderate-to-severe TBI or a history of moderate-to-severe TBI. However, literature on nurses' perceived knowledge to care for patients with TBI exists, but only focuses on: a) nursing management of patients with TBI and their families during the acute phase (Coco, Tossavainen, Jääskeläinen, & Turunen, 2011); b) care of pediatric (Cook et al., 2013); or adult patients with mild TBI (Watts et al., 2011); and c) nursing students' misconceptions or misattributions about patients with TBI (Linden & McClure, 2012). This presents a gap in knowledge on nurses' perceived knowledge and perceived confidence to care for patients with moderate-to-severe TBI.

Lack of research on this topic could have a negative influence on effective communication with and education of patients with moderate-to-severe TBI and their families. Patients and families are often concerned with expectations pertaining to recovery after TBI and speak with healthcare providers to obtain information and education (Turner, Fleming, Ownsworth, & Cornwell, 2011). Nurses are often in a position to provide such information to patients and family members, as they are typically in close proximity to patients and families and interact with them on a very frequent basis (Pieper & Bear, 2011). Nurses' perceived knowledge and perceived confidence on areas such as assessment and treatment procedures and rehabilitation and recovery after moderate-to-severe TBI might influence the education nurses provide to patients and their families, particularly if inaccurate knowledge and perceptions are held. Prior to understanding how nurses' perceptions influence care of patients with moderate-to-severe TBI, we must first understand nurses' perceptions of caring for these patients. Our study aims to fill the gap in knowledge on this topic.

Thus, the purpose of this study is to determine nurses' perceived knowledge and perceived confidence to care for patients with moderate-to-severe TBI. The objectives of this exploratory, cross-sectional study were to determine: (1) nurses' perceived knowledge about aspects of TBI and TBI care, (2) nurses' perceived confidence to perform specific care tasks for patients with TBI; and (3) nurses' level of training specific to care of patients with TBI. As there is no literature on the relationship between nurses' perceived knowledge and perceived confidence to care of patients with moderate-to-severe TBI to use in developing a hypothesis, we conducted a preliminary, exploratory study to investigate the relationship between these variables and other auxiliary variables.

Methods

Design & Data Collection

This study used a cross-sectional, exploratory design. In October 2014, an email invitation with the link to the electronic survey was sent to all (N=2,523) registered nurses at a large, Midwestern hospital in the U.S., with two follow-up email reminders (each two weeks apart). Nurses were eligible to participate if they were registered nurses and employed by the participating hospital. Primary places of employment included emergency room, ambulatory clinic/physician office, inpatient unit, and other. This study was approved by the participating institutional review board, including a waiver of obtaining written informed consent from study participants.

Survey Items

Authors developed the Perceptions of Brain Injury Survey (PBIS) by adapting two surveys: 1) a survey about school speech-language pathologists' perceived knowledge of and perceived confidence to provide services to students with TBI (Hux, Walker, & Sanger, 1996), and 2) a survey on nurses' perceived knowledge and learning preferences regarding care of patients with mild TBI (Watts et al., 2011). Findings in this article focus on perceived knowledge, perceived confidence, and TBI-related training. Information about the development of the PBIS and the structure and psychometrics of the final PBIS are reported elsewhere (Oyesanya, Turkstra, & Brown, under review). As Cronbach's alpha is known to

underestimate reliabilities (Novick & Lewis, 1967), McDonald's omega coefficient (ω) is reported here for each subscale (McDonald, 1970). McDonald's omega coefficient is a reliability measure that indicates whether items measure the same latent variable (McDonald, 1970).

Perceived Knowledge—Twenty items asked nurses' about their perceived knowledge on various nursing care topics. Nurses were asked about their perceived knowledge of clinical guidelines, nursing care plans, medication management, stages of recovery, and treatment and therapy options. Perceived knowledge items were in a check-all-that-apply and Likert-type scale format with a 4-point scale with the following ratings: 1= none, 2= some, 3= moderate and 4= expert. Nurses with higher scores on this subscale had higher perceived knowledge ($\omega=0.99$) (see Supplementary File to review survey items).

Perceived Confidence—Twenty-nine items focused on nurses' perceived confidence to conduct a list of nursing roles and responsibilities specific to non-acute care of patients with TBI and their families, along with assessment and treatment procedures. Perceived confidence items were in a check-all-that-apply format. Higher scores on this subscale indicate higher perceived confidence ($\omega=0.98$).

Training—There were 11 items focused on nurses' prior TBI-related training. Questions were asked about prior training history, including types of training, and frequency of providing care to patients with TBI. These questions were in a multiple choice, yes/no, and check-all-that-apply. Higher scores indicate nurses have more training to care for patients with moderate-to-severe TBI ($\omega=0.89$).

Demographics—Finally, demographic questions asked about age, sex, prior nursing education, total number of years in active nursing practice, total number of years in current nursing position, primary place of employment, and primary role as a nurse.

Data Analysis

Latent class analysis (LCA), a subset of structural equation modeling, is commonly used to detect homogeneity in a heterogeneous group by assessing relationships between responses on a set of indicators (Clogg, 1995). LCA is based on the assumption that participants differ in responses based on an observable latent trait (Clogg, 1995). LCA was used to locate homogeneous subgroups of nurses' perceptions of knowledge about aspects of TBI and TBI care (Objective #1). Authors then conducted exploratory and confirmatory factor analysis on perceived confidence items. Next, LCA was used to identify differences based on perceived knowledge in areas such as perceived confidence (Objective #2) and TBI-related training (Objective#3), as well as other auxiliary variables (demographics). We used Mplus version 7.3 to conduct the analyses described below, including determining the class structure (Muthén & Muthén, 2010).

Class structure was determined using perceived knowledge items. To determine class structure, we used the following criteria: 1) interpretability; 2) theoretical justification; 3) parsimony; 4) entropy variable > 0.7 (Celeux & Soromenho, 1996); 5) the lowest Akaike's information criterion (AIC), Bayesian information criterion (BIC), and adjusted BIC (Fraley

& Raftery, 1998); 6) average posterior probability for each class (must be >0.75 with no more than 10% overlap between non-contiguous clusters); 7) at least 2.5% of total sample size in each group; 8) no significant improvement as assessed by Lo-Mendell Rubin and Vuong-Lo-Mendell-Rubin likelihood ratio tests. Table 2 lists AIC, BIC, adjusted BIC, results of both likelihood ratio tests, and p -values for these tests to indicate if the improvement in model fit was significant (Fraley & Raftery, 1998). After identifying the class structure, each participant was assigned to a latent class according to his/her maximal posterior probability.

Outcome of the LCA

The LCA showed that a 3-class structure for the perceived knowledge items had the best model fit (lowest AIC, BIC, adjusted BIC, and highest entropy with significant likelihood ratio tests). The three classes were defined as low ($n=133$), moderate ($n=242$), and high ($n=138$) perceived knowledge. Classes were determined based on perceived knowledge of nursing topics specific to caring for patient with TBI, including: clinical guidelines, nursing care plans, medication management, stages of recovery, and treatment and therapy options (see Supplementary File to review survey items). Information on goodness of fit for each of the tested class structures is listed in Table 2. Results from both the Lo-Mendell-Rubin and Vuong-Lo-Mendell Rubin likelihood ratio tests confirmed that the 3-class structure had a significant improvement in model fit compared to the 2-class structure. The results from both likelihood ratio tests also confirmed that the 4-class structure did not improve the model fit when compared to the 3-class structure. Based on the criteria for determining class structure listed above, the 3-class structure was the best fit for our data (see Figure 1).

Exploratory and Confirmatory Factor Analysis of Perceived Confidence Items

Next, we used both exploratory and confirmatory factor analysis to develop a factor structure for the perceived confidence items. We began with exploratory factor analysis because a priori hypothesis on the structure of perceived knowledge and perceived confidence was not found in the literature (Kroonenberg & Lewis, 1982; Suhr, 2006). We used exploratory factor analysis to sequentially fit several models to the data set to determine a reasonable model fit (Kroonenberg & Lewis, 1982). Next, we used confirmatory factor analysis to confirm the model fit (Kroonenberg & Lewis, 1982; Suhr, 2006). This is considered the single sample approach, which is an alternative to the commonly used split sample approach (Kroonenberg & Lewis, 1982). The single sample approach is known to be more effective when data are guided by theory and clinical judgment (Kroonenberg & Lewis, 1982), similar to the data collected in this sample.

To conduct an exploratory and confirmatory factor analysis, Kroonenberg & Lewis (1982) recommend using the following steps: 1) perform an exploratory factor analysis; 2) adjust loadings by finding the largest loading in each column and setting the other loadings in the same rows to zero; 3) perform a confirmatory factor analysis; 4) set small loadings to zero to simplify the model; 5) perform a new confirmatory factor analysis using these restrictions; 6) examine the simplified model for appropriate fit; 7) if necessary, drop restrictions on loading(s), rerun confirmatory factor analysis, and examine the simplified model for

appropriate fit; 8) stop if simplified model is satisfactory; 9) relax simplified model if it is too restrictive.

Beginning with step 1, we used MPlus to run an exploratory factor analysis on the items in the perceived confidence items. Next, authors used the following fit indices to determine appropriateness of the simplified model: the Comparative Fit Index (CFI), Tucker Lewis Index (TLI), standardized root mean square residual (SRMR), and standardized factor loadings; we also used chi-square test of model fit (Suhr, 2006) to determine the fit of the model. The closer the CFI, TLI, and standardized factor loadings are to 1, the better the fit of the factor structure (Suhr, 2006). Similar to the LCA, we also used AIC, BIC, and Adjusted BIC to determine the overall fit of the factor structure (Suhr, 2006).

After completing steps 1 and 2 outlined by Kroonenberg and Lewis (1982), the proposed model for the perceived confidence items had two factors (29 items). Next, steps 3 to 9 recommended by Kroonenberg and Lewis (1982) were performed to confirm the theorized factor structure and find a simplified model with a reasonable fit for the perceived confidence items, which was done by conducting a confirmatory factor analysis.

Outcome of Confirmatory Factor Analysis of Perceived Confidence Items

The following model fit indices were requested in MPlus while running a confirmatory factor analysis to confirm the theorized structure of the perceived confidence items: Comparative Fit Index (CFI); Tucker Lewis Index (TLI); chi-square test of model fit; root mean square error of approximation (RMSEA); weighted root mean square residual (WRMR); and standardized factor loadings. The above listed model fit indices suggested the 2-factor model for the perceived confidence items had a reasonable fit. Details about the factor structure of perceived confidence are reported elsewhere (Oyesanya et al., under review).

Factor 1 (reflective of roles and responsibilities) consisted of items on perceived confidence to conduct nursing roles and responsibilities specific to caring for patients with moderate-to-severe TBI, including: 1) interaction with patients, families, and other health care providers, 2) communication of patient-specific information, including providing patients, families, and colleagues with information about caring for a patient with TBI; and 3) developing a person- and family-centered care plan. Factor 2 (reflective of assessment procedures and treatment procedures) was specific to perceived confidence to assess and treat deficits in a patient's level of consciousness, spontaneous movement and muscle tone, pupil size and reactivity, reflexes, muscle tone and posturing, and respiratory pattern, somatic complaints and response, and pain. Perceived confidence items were in a check-all-that-apply format (see Supplementary File). Higher scores on this subscale indicate higher perceived confidence.

Pairwise Comparisons of Auxiliary Variables

Finally, we used the 3-class structure identified by the LCA to conduct pairwise comparisons for auxiliary variables (i.e., demographics, perceived confidence, and TBI-related training) using two-sample t-tests. Table 3 shows mean and percentage values for demographic items based on class/group and Table 4 shows mean and percentage values for perceived confidence and TBI-Related training items based on class/group. Pairwise comparisons for

means and percentages, including significance levels are also listed in each table. In addition, each table lists the calculated effect size of each pairwise comparison, useful for interpretation of clinical significance. Hedges' effect size (g) was calculated for mean values (Cooper, Hedges, & Valentine, 2009) and Cohen's proportional difference effect size (h) was calculated for percentage values (Borenstein, Hedges, Higgins, & Rothstein, 2009), both using a 95% confidence interval.

Finally, we used False Discovery Rate (FDR) to correct for multiple pairwise comparisons. Compared to correction techniques such as Bonferroni, FDR is a liberal correction used to control type I error rates (Verhoeven, Simonsen, & McIntyre, 2005). An FDR correction was conducted for each family-specific or sub-scale domain. Adjusted p-values were assessed for significance at $p = .05$ and are listed in Table 3 and 4.

Results

Sample Size and Response Rate

Of the 2,523 nurses who received the email invitation, 513 completed the PBIS. The response rate of full survey completion was 20.3%. We defined response rate as the number of reporting units (e.g., the number of completed surveys) divided by the number of eligible reporting units (e.g., the number of nurses that received the email invitation) (Couper & Miller, 2008). In electronic surveys, typical response rates are 20% or lower (Shih & Fan, 2009), therefore, our response rate is considered acceptable. Sample characteristics are described in Table 1.

Perceived Knowledge

Using latent class analysis, authors were able to divide the sample into three homogenous groups based on the perceived knowledge items: low, moderate, and high perceived knowledge. The sample size of each subgroup varied. The low perceived knowledge group had 133 nurses (27.4% of sample), the moderate perceived knowledge group had 242 (45.7% of sample), and the high perceived knowledge group had 138 (26.9% of sample). Analysis of auxiliary variables in each subgroup (i.e., demographics, perceived confidence, and TBI-related training) showed significant differences (see Table 3 and 4).

Demographics

The majority of nurses in the low, moderate, and high perceived knowledge group were female and identified as staff registered nurses. Although most nurses from all groups worked on an inpatient unit, the low perceived knowledge nurses had the highest number of nurses from an inpatient unit (70.7%), followed by the moderate (55.4%), and high perceived knowledge nurses (43.5%). The moderate perceived knowledge nurses were the youngest (37.34 years), followed by the low (37.67 years) and high perceived knowledge nurses (39.91 years). The low and moderate perceived knowledge nurses received their highest nursing degree approximately 10 years ago, had approximately 12 years of active nursing practice, and had over 5 years of nursing practice at their current position. In contrast, the high perceived knowledge nurses received their highest nursing degree 14.24

years ago and had the most nursing experience, with 14.24 years in active nursing practice and 6.84 years at their current nursing position (Table 3).

Perceived Confidence

Nurses in the low perceived knowledge group had the highest means on both factors of perceived confidence, followed by the moderate perceived knowledge nurses. The high perceived knowledge nurses had the lowest means on both perceived confidence factors compared to the low and moderate perceived knowledge groups (see Table 4).

TBI-Related Training

Nurses from all three perceived knowledge groups saw patients with moderate-to-severe TBI at the same rate, 1-2 patients with moderate-to-severe TBI per month. A mean between 2.50 and 3.50 on the frequency of care variable was interpreted as 1-2 patients with moderate-to-severe TBI per month, regardless of sex of the patient. The low perceived knowledge group nurses reported the highest percentage of ever practicing with patients with moderate-to-severe TBI and of ever having completed specific TBI-related training. Moderate perceived knowledge nurses had the second highest rates of practicing with patients with TBI and receiving TBI-related training, followed by high perceived knowledge groups. For those who had completed specific TBI-Related training in the low perceived knowledge group, the training occurred, on average, more than 4 years ago, which was the shortest time since TBI-related training of all three groups. In comparison, the moderate perceived knowledge nurses completed TBI-related training an average of 6 years ago and high perceived knowledge nurses completed their TBI-related training an average of 10 years ago. Regardless of group, of those with TBI-related training, the most common type of training was continuing education. The most common location of TBI-related training was conferences or workshops.

Discussion

The purpose of this study was to investigate nurses': 1) perceived knowledge about aspects of TBI and TBI care, 2) perceived confidence to perform specific care tasks for patients with TBI; and 3) level of training specific to care of patients with TBI. Using latent class analysis, authors were able to divide nurses in this study into three homogenous sub-groups based on perceived knowledge: low, moderate, and high. Findings show that nurses who report more experience caring for patients with TBI have the highest perceived confidence but the lowest perceived knowledge. The low perceived knowledge group nurses had the highest rate of experience practicing with patients with moderate-to-severe TBI, specific TBI-related training, and overall perceived confidence. In comparison, the moderate perceived knowledge group had the second highest rate of experience practicing with patients with moderate-to-severe TBI and specific TBI-related training, as well as perceived confidence. Surprisingly, the highest perceived knowledge group had the lowest rate of experience practicing with patients with moderate-to-severe TBI, specific TBI related training, and perceived confidence on all factors. These findings were counterintuitive. One would predict that nurses who perceive that they have more knowledge would have more experience practicing with patients with moderate-to-severe TBI, more training, and more perceived

confidence, but this was not the case. Perhaps this can be described as “the more you know, the more you realize your limitations.”

This grouping of nurses based on perceived knowledge revealed perceptions that mapped onto the Conscious Competence Learning Model, which is used to describe experiential learning (Cannon, Feinstein, & Friesen, 2014). The Conscious Competence Learning Model consists of four stages, which are often depicted in a cyclical format. Movement from one stage to another is based on feedback and self-reflection (stage 1 to stage 2), practice and self-monitoring (stage 2 to stage 3), reflection and automatism, (stage 3 to stage 4), and improvement and self-growth (stage 4 to stage 1) (Cannon et al., 2014).

Stage 1, the unconscious incompetence phase, is characterized with using intuition and limited insight to solve problems (Cannon et al., 2014). People in this stage are unaware of the skills that they lack (referred to by Cannon as a “blindspot”). The low perceived knowledge group can be compared to the unconscious incompetence phase, which explains our findings of low perceived knowledge and high perceived confidence. The moderate knowledge group can be compared to the conscious incompetence phase, stage 2 (Cannon et al., 2014). People in the conscious incompetence phase recognize problems using their intuition, attempt to use logic to solve problems, and are more aware of problem-solving skills they lack. This stage explains our findings of moderate perceived knowledge and moderate perceived confidence in this group. The high perceived knowledge group can be likened to the conscious competence phase, stage 3, which is characterized by having acquired skills that are useful in logical problem solving, along with awareness of present skills and skills that are lacking (Cannon et al., 2014). The findings of high perceived knowledge and low perceived confidence in this group are likely similar to what is experienced during the conscious competence stage. Finally, the unconscious competence phase, stage 4, is characterized by having intuitive skills to solve problems logically and applying these skills spontaneously to new situations (Cannon et al., 2014). Nurses in this stage have extensive experience, can problem solve unconsciously in a logical manner, and are unaware of the skills they have. Stage 4 is a goal for healthcare providers. We did not have any findings representative of this stage. Although this study focuses on nurses, these findings may apply to other types of healthcare providers.

The limited research on nurses’ perceived knowledge specific to caring for patients with TBI emphasizes the importance of nurses having accurate knowledge to care for these patients. A study focusing on nurses’ perceived knowledge to care for patients with mild TBI, which also included nurses who did and did not provide care to patients with TBI on a regular basis (Watts et al., 2011), had similar findings compared to our study. According to Watts et al. (2011), nurses in their sample cared for patients with mild TBI at a similar frequency as nurses in our study who cared for patients with moderate-to-severe TBI; most nurses from both the Watts et al. (2011) sample and our sample saw at least 1-2 patients with TBI per month. Although Watts et al. (2011) did not use a statistical analysis technique to divide nurses into homogenous subgroups based on perceived knowledge like we did, their findings show many nurses had low perceived knowledge to care for patients with mild TBI. Few nurses in their sample (ranging from 15-39.8%) reported a high level of perceived knowledge on various nursing care roles and responsibilities (Watts et al., 2011). In contrast,

our findings show nurses who report caring for patients with moderate-to-severe TBI the most have the highest perceived confidence, but the lowest perceived knowledge. Our findings build on those of Watts et al. (2011) and add new knowledge to the literature on nurses' care of patients with moderate-to-severe TBI, such as new information on nurses' variations in perceived knowledge, perceived confidence, and TBI-related training. Taken together, these findings emphasize the need for additional education and training for nurses who care for these patients.

Evidence-based practice guidelines emphasize the importance of having appropriate resources available to care for patients, including specialized training of staff, which helps protect the health of patients (Thoroddsen, Ehnfors, & Ehrenberg, 2010). Specialized training and education about caring for patients with TBI provides the nurse with knowledge of the pathophysiology of TBI, how to interpret the patient's assessments and corresponding treatments, current evidence-based practice guidelines, and strategies for collaborating with the interdisciplinary team (McQuillan & Mitchell, 2002). This specialized knowledge allows the nurse to maintain and improve the patient's cognitive, psychosocial, and emotional health (McQuillan & Mitchell, 2002). When patients have specific medical conditions, nurses must have corresponding specific knowledge, so they can achieve outcomes predicted by best practice research (Thoroddsen et al., 2010).

Most nurses from all groups reported high rates of experience practicing with patients with moderate-to-severe TBI, but had limited TBI-related training. The low levels of TBI-related training across all respondents are concerning given the above-noted links between training and patient outcomes. Variations in training also could lead to inconsistencies in quality of patient care (Seel et al., 2015). The complex roles and responsibilities of nurses caring for patients with TBI, including providing care during acute and non-acute phases of recovery, support the need for specialized provider training and education (Long et al., 2002).

Relevance to Clinical Practice

These findings have implications for clinical practice globally. First, there is a high incidence of TBI in the U.S. and around the world, which increases the number of patients with TBI that seek care from nurses on a regular basis. This emphasizes the need for nurses to have adequate knowledge to care for these patients. Second, continuing education in specialty areas often is self-directed, and nurses who believe they are knowledgeable about TBI might not seek out opportunities for training and education in this area. Training based on formal assessment of knowledge might be more effective than relying on nurses' perceptions, particularly in an area in which knowledge is rapidly evolving and could substantially alter care plans. An example is the conceptualization of TBI as a chronic disease (Corrigan & Hammond, 2013). Third, the PBIS can provide direction to determine inaccurate perceptions before educating and training nurses. This survey can be used by clinicians to determine baseline perceived knowledge, perceived confidence, and training to care for patients with TBI. Education and training for individual nurses, nurses on specific units, or all nurses at the hospital level can be tailored accordingly.

Fourth, the data revealed specific areas in which nursing care could be improved, such as effective communication and teaching strategies for patients with TBI who have cognitive

impairments. For example, many of the published disability accommodations for students with TBI are directly applicable to nursing care. These accommodations include: a) decreasing distractions in the immediate environment, to compensate for attention problems; b) dividing teaching into smaller sessions and using simplified language, to address cognitive fatigue; c) using written notes to compensate for memory impairments; and d) repeating information frequently (Tyler, Blosser, & DePompei, 1999). Any of these accommodations could be implemented in nursing practice.

Fifth, the complex clinical care needed for patients with moderate-to-severe TBI suggests the need for additional clinical guidelines to direct non-acute care. The majority of available nursing clinical guidelines focus on care of patients with mild TBI or critical care of patients with severe TBI. We could find no nursing-specific clinical guidelines for post-acute medical and rehabilitation care of patients with moderate-to-severe TBI. The Brain Injury Association of America has also called for TBI researchers and clinicians to develop and distribute TBI rehabilitation guidelines to improve patient care (Brain Injury Association of America, 2014). More clinical guidelines are needed to ensure care of patients with moderate-to-severe TBI is directed by evidence-based practice.

Limitations

A convenience sample was used to recruit participants from a single hospital. We choose to survey all nurses from one hospital and its affiliated clinics, regardless of specialty or work setting, frequency of care or training to care for patients with moderate-to-severe TBI. Therefore, findings may not be representative of nurses worldwide who frequently care for patients with TBI. This was suitable for our purposes as this is a preliminary, exploratory study. Also, when asking about frequency of providing care to patients with TBI, we did not specify whether we were focusing on new moderate-to-severe TBI or a history of moderate-to-severe TBI and nurses may have answered questions only in reference to new moderate-to-severe TBI. It is likely that the mean percentage of those who have experience practicing with patients with TBI and frequency of providing care to patients with TBI is higher when including both new TBI and a history of TBI. We chose not to differentiate between new and a history of TBI to allow for easier data collection. Finally, this study only focused on nurses' perceptions of knowledge and confidence but did not test actual knowledge levels. This was suitable for our purposes because understanding nurses' perceptions is the first of multiple studies focused on nursing care of patients with moderate-to-severe TBI.

Future Research

Although we chose to survey nurses across hospital departments, future research might focus on nurses who frequently care for patients with TBI, such as emergency room, ICU, trauma, and rehabilitation nurses. We surveyed nurses across hospital departments because patients with TBI can be found on any hospital unit, but education and training needs might differ depending on the type of care needed. Because TBI is a chronic disease (Corrigan & Hammond, 2013), future research also should ask separately about patients with new TBI vs. a history of TBI, as these groups have different care requirements. A related gap in the literature is information about how best to care for patients who are likely to have chronic health and cognitive problems, and how this translates into the discharge process. Finally,

future research should include a valid and reliable test of nurses' actual knowledge to care for these patients to better identify gaps in knowledge, including areas where additional training and education are needed.

Conclusion

This study demonstrated differences among nurses in perceived knowledge, perceived confidence, and TBI-related training. Variability on all variables of focus across nurses supports the development and testing of educational and training interventions for all nurses, to ensure consistency of care for patients and optimize patient outcomes. Although nurses may vary in the frequency with which they care for patients with moderate-severe TBI, all nurses should be knowledgeable about caring for these patients as they patients can be found on any hospital unit, around the world.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

- Borenstein, M., Hedges, LV., Higgins, JPT., Rothstein, HR. Introduction to Meta-Analysis. John Wiley & Sons, Ltd.; 2009. Effect Sizes Based on Binary Data (2x2 Tables); p. 33-39. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/9780470743386.ch5/summary>
- Brain Injury Association of America. BIAA frequently asked questions. 2012. Retrieved from <http://www.biausa.org/FAQRetrieve.aspx?ID=43913>
- Brain Injury Association of America. Guidelines for the rehabilitation and chronic disease management of adults with moderate to severe traumatic brain injury. 2014. Retrieved from <http://www.biausa.org/TBIGuidelines/tbi-rehabilitation-guidelines>
- Brain Injury Association of America. Living with brain injury. 2015. Retrieved from <http://www.biausa.org/living-with-brain-injury.htm>
- Cannon HM, Feinstein AH, Friesen DP. Managing Complexity: Applying the Conscious-Competence Model to Experiential Learning. Developments in Business Simulation and Experiential Learning. 2014; 37 Retrieved from <https://absel-ojs-ttu.tdl.org/absel/index.php/absel/article/view/306>.
- Celeux G, Soromenho G. An entropy criterion for assessing the number of clusters in a mixture model. Journal of Classification. 1996; 13(2):195–212.
- Centers for Disease Control and Prevention. Report to congress on traumatic brain injury in the United States: Epidemiology and Rehabilitation. National Center for Injury Prevention and Control; Division of Unintentional Injury Prevention; Atlanta, GA: 2014.
- Clogg, CC. Handbook of statistical modeling for the social and behavioral sciences. Springer; 1995. Latent class models; p. 311-359. Retrieved from http://link.springer.com/chapter/10.1007/978-1-4899-1292-3_6

- Coco K, Tossavainen K, Jääskeläinen JE, Turunen H. Support for traumatic brain injury patients' family members in neurosurgical nursing: a systematic review. *Journal of Neuroscience Nursing*. 2011; 43(6):337–348. [PubMed: 22089411]
- Cook RS, Gillespie GL, Kronk R, Daugherty MC, Moody SM, Allen LJ, Falcone RA. Effect of an educational intervention on nursing staff knowledge, confidence, and practice in the care of children with mild traumatic brain injury. *The Journal of Neuroscience Nursing: Journal of the American Association of Neuroscience Nurses*. 2013; 45(2):108–118. <http://doi.org/10.1097/JNN.0b013e318282906e>. [PubMed: 23422697]
- Cooper, H., Hedges, LV., Valentine, JC. *The handbook of research synthesis and meta-analysis*. Russell Sage Foundation; 2009. Retrieved from <https://books.google.com/books?hl=en&lr=&id=LUGd6B9eyc4C&oi=fnd&pg=PR7&dq=hedges+effect+size&ots=5NDFyZ-r5Q&sig=yVAHG2h2xBMURopblEvwAursdhw>
- Corrigan JD, Hammond FM. Traumatic brain injury as a chronic health condition. *Archives of Physical Medicine and Rehabilitation*. 2013; 94(6):1199–1201. [PubMed: 23402722]
- Couper MP, Miller PV. Web survey methods introduction. *Public Opinion Quarterly*. 2008; 72(5):831–835.
- Faul, M., Xu, L., Wald, M., Coronado, V. Traumatic brain injury in the united states: emergency department visits, hospitalizations and deaths 2002–2006. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; Atlanta, GA: 2010.
- Finkelstein, EA., Corso, PS., Miller, TR. *The incidence and economic burden of injuries in the United States*. Oxford University Press; New York, NY: 2006.
- Fraley C, Raftery AE. How many clusters? Which clustering method? Answers via model-based cluster analysis. *The Computer Journal*. 1998; 41(8):578–588.
- Grol R. Beliefs and evidence in changing clinical practice. *British Medical Journal*. 1997; 315(7105): 418–421. [PubMed: 9277610]
- Hux K, Walker M, Sanger DD. Traumatic Brain Injury Knowledge and Self-Perceptions of School Speech-Language Pathologists. *Language, Speech, and Hearing Services in Schools*. 1996; 27(2): 171–184.
- Hyder AA, Wunderlich CA, Puvanachandra P, Gururaj G, Kobusingye OC. The impact of traumatic brain injuries: a global perspective. *NeuroRehabilitation*. 2007; 22(5):341–353. [PubMed: 18162698]
- Kroonenberg PM, Lewis C. Methodological issues in the search for a factor model: Exploration through confirmation. *Journal of Educational and Behavioral Statistics*. 1982; 7(2):69–89.
- Linden MA, McClure J. The causal attributions of nursing students toward adolescent survivors of brain injury. *Nursing Research*. 2012; 61(1):58–65. [PubMed: 22166910]
- Long AF, Kneafsey R, Ryan J, Berry J. The role of the nurse within the multi-professional rehabilitation team. *Journal of Advanced Nursing*. 2002; 37(1):70–78. [PubMed: 11784400]
- McDonald RP. The theoretical foundations of principal factor analysis, canonical factor analysis, and alpha factor analysis. *British Journal of Mathematical and Statistical Psychology*. 1970; 23(1):1–21. <http://doi.org/10.1111/j.2044-8317.1970.tb00432.x>.
- McQuillan, KA., Mitchell, PH. Traumatic brain injuries. In: McQuillan, KA. Von Rueden, K. Hartstock, RL. Flynn, MB., Whalen, E., editors. 3rd edition. W. B. Saunders Company; Philadelphia, PA: 2002. p. 394–461.
- Millis SR, Rosenthal M, Novack TA, Sherer M, Nick TG, Kreutzer JS, Ricker JH. Long-term neuropsychological outcome after traumatic brain injury. *The Journal of Head Trauma Rehabilitation*. 2001; 16(4):343–355. [PubMed: 11461657]
- Muthén, LK., Muthén, BO. *Mplus User's Guide: Statistical Analysis with Latent Variables: User's Guide*. Muthén & Muthén; 2010.
- Novick MR, Lewis C. Coefficient alpha and the reliability of composite measurements. *Psychometrika*. 1967; 32(1):1–13. [PubMed: 5232569]
- Oyesanya, TO., Turkstra, LS., Brown, RL. Nurses' perceptions of caring for patients with traumatic brain injury: A psychometric study. under review
- Pieper P, Bear M. Child and proxy perspectives of the child's health-related quality of life 1 month after a mild traumatic brain injury. *Journal of Trauma Nursing*. 2011; 18(1):11–17.

- Povlishock JT, Katz DI. Update of neuropathology and neurological recovery after traumatic brain injury. *The Journal of Head Trauma Rehabilitation*. 2005; 20(1):76–94. [PubMed: 15668572]
- Rao V, Bertrand M, Rosenberg P, Makley M, Schretlen D, Brandt J, Mielke M. Predictors of new-onset depression after mild traumatic brain injury. *The Journal of Neuropsychiatry and Clinical Neurosciences*. 2010; 22(1):100–104. [PubMed: 20160216]
- Seel RT, Barrett RS, Beaulieu CL, Ryser DK, Hammond FM, Cullen N, Horn SD. Institutional variation in traumatic brain injury acute rehabilitation practice. *Archives of Physical Medicine and Rehabilitation*. 2015; 96(8):S197–S208. [PubMed: 26212397]
- Shih T-H, Fan X. Comparing response rates in e-mail and paper surveys: A meta-analysis. *Educational Research Review*. 2009; 4(1):26–40. <http://doi.org/10.1016/j.edurev.2008.01.003>.
- Suhr, DD. Exploratory or confirmatory factor analysis?. SAS Institute, Inc.; Cary: 2006. p. 1-17.
- Thoroddsen A, Ehnfors M, Ehrenberg A. Nursing specialty knowledge as expressed by standardized nursing languages. *International Journal of Nursing Terminologies and Classifications*. 2010; 21(2):69–79. [PubMed: 20500613]
- Turner BJ, Fleming J, Ownsworth T, Cornwell P. Perceived service and support needs during transition from hospital to home following acquired brain injury. *Disability and Rehabilitation*. 2011; 33(10): 818–829. [PubMed: 20812814]
- Tyler, J., Blosser, J., DePompei, R. Teaching strategies for students with brain injuries. Lash and Associates Publishing/Training Inc.; Wake Forest, NC: 1999.
- Vanderploeg RD, Schwab K, Walker WC, Fraser JA, Sigford BJ, Date ES, Warden DL. Rehabilitation of traumatic brain injury in active duty military personnel and veterans: Defense and Veterans Brain Injury Center randomized controlled trial of two rehabilitation approaches. *Archives of Physical Medicine and Rehabilitation*. 2008; 89(12):2227–2238. [PubMed: 19061734]
- Verhoeven KJ, Simonsen KL, McIntyre LM. Implementing false discovery rate control: Increasing your power. *Oikos*. 2005; 108(3):643–647.
- Watts DD, Gibbons S, Kurzweil D. Mild traumatic brain injury: A survey of perceived knowledge and learning preferences of military and civilian nurses. *Journal of Neuroscience Nursing*. 2011; 43(3): 122–129. [PubMed: 21796028]

Summary/Key Points

What does this paper contribute to the wider global clinical community?

- Nurses worldwide, regardless of hospital setting, are likely to see patients with traumatic brain injury (TBI) depending on severity of injury, time since injury, and comorbidities. Patients with TBI and their families are often concerned with expectations about recovery and seek information from nurses. However, nurses' perceptions of care might influence information provided to patients and families, particularly if inaccurate knowledge and perceptions are held.
- A cross-sectional survey was completed electronically by 513 nurses between October and December 2014 to determine nurses' perceptions about caring for patients with TBI. Authors were able to divide nurses into three homogenous sub-groups based on perceived knowledge: low, moderate, and high. Findings showed nurses who care for patients with TBI the most have the highest perceived confidence but the lowest perceived knowledge. Nurses also had significant variations in training.
- These findings have implications for educating nurses globally about care of patients with TBI, including direction for development and testing of nursing educational interventions.

Figure 1. 3-Class Structure Based on Perceived Knowledge Items

Table 1**Demographics and Professional Background (n=513)**

Variables	n (%)
Age, mean years (SD)	38.19 ($\pm$ 11.45)
Sex	
Male	48 (9.35%)
Female	465 (90.65%)
Nursing education	
Associates	69 (13.45%)
Diploma	11 (2.14%)
Bachelors'	370 (72.12%)
Masters' or Doctorate	63 (12.29%)
Total years in active nursing practice, mean years (SD)	12.69 ($\pm$ 10.995)
Total years in current nursing position, mean years (SD)	5.91 ($\pm$ 6.517)
Primary Place of Employment	
Primary Care Clinic	14 (2.72%)
Emergency Room	25 (4.87%)
Ambulatory Clinic or MD Office	93 (18.12%)
Inpatient Unit	288 (56.14%)
Other	109 (21.24%)
Primary Role	
Staff Registered Nurse	409 (79.73%)
Nurse Practitioner/Clinic Nurse Specialist/CRNA	26 (5.07%)
Division Officer/Charge RN/Care Team Leader	31 (6.04%)
Department Head/RN Supervisor/Nurse Manager	15 (2.92%)
Other	32 (6.24%)

Table 2
Goodness-of-Fit Statistics and Likelihood Ratio Tests of Latent Class Analysis Models
Containing Different Numbers of Classes

Goodness-of-Fit Statistics				
Latent Class Models	Entropy	AIC	BIC	Adjusted BIC
1-Class Model	-	15484.42	15649.79	15525.99
2-Class Model	0.978	11713.49	12048.47	11797.71
3-Class Model	0.975	9722.44	10227.04	9849.31
4-Class Model	0.980	9050.95	9725.16	9220.47

Likelihood Ratio Tests		
Class Comparison	Vuong-Lo-Mendell-Rubin LRT	Lo-Mendell-Rubin LRT
1-Class model vs. 2-class model	3850.93, P<0.001	3835.56, P<0.001
2-Class model vs 3-class model	2071.05, P<0.001	2062.78, P< 0.001
3-Class model vs 4-class model	751.49, P=0.734	748.49, P=0.735

Table 3

Mean/Percent Values and Pairwise Comparisons and Effect Size Calculations of Demographic Items by Latent Class (n=513)

Demographic Items	Perceived Knowledge Classes				P-values for Mean Pairwise Comparisons Between Paired Classes				Hedges' Effect Size Calculations ¹ for Mean Differences Between Paired Classes			
	Low Perceived Knowledge (n=133) mean (SD)	Moderate Perceived Knowledge (n=242) mean (SD)	High Perceived Knowledge (n=138) mean (SD)		Low vs. Moderate Perceived Knowledge	Low vs. High Perceived Knowledge	Moderate vs. High Perceived Knowledge		Low vs. Moderate Perceived Knowledge	Low vs. High Perceived Knowledge	Moderate vs. High Perceived Knowledge	
Age, mean years	37.67 (10.94)	37.34 (11.62)	39.91 (11.96)		p = 0.81	p = 0.19	p = 0.12		g = 0.03	g = -0.20	g = -0.22	
Highest level of nursing education	2.00 (0.58)	1.96 (0.54)	1.96 (0.52)		p = 0.68	p = 0.66	p = 1.00		g = 0.07	g = 0.07	g = 0.00	
Primary role	2.27 (0.75)	2.15 (0.64)	2.09 (0.63)		p = 0.18	p = 0.07	p = 0.60		g = 0.27	g = 0.26	g = 0.08	
Years since graduation from highest nursing degree	10.07 (8.94)	10.36 (10.04)	12.86 (11.37)		p = 0.81	p = 0.05	p = 0.09		g = 0.18	g = 0.26	g = 0.09	
Total years in active nursing practice, years	12.29 (9.87)	12.07 (11.05)	14.24 (11.83)		p = 0.85	p = 0.22	p = 0.18		g = 0.02	g = -0.18	g = -0.19	
Total years in current nursing position, years	5.49 (5.94)	5.85 (6.84)	6.46 (6.50)		p = 0.74	p = 0.55	p = 0.60		g = -0.05	g = -0.16	g = -0.09	

	P-values for Percent Pairwise Comparisons Between Paired Classes			Cohen's Proportional Difference Size Calculations ² for Percentage Differences Between Paired Classes		
	% (SD)	% (SD)	% (SD)			
Sex, female	90.23% (0.29)	89.26% (0.31)	93.48% (0.25)	p = 0.81	p = 0.43	p = 0.36
Current work setting						
Primary care clinic	3.6% (0.19)	2.1% (0.14)	2.9% (0.17)	p = 0.43	p = 0.75	p = 0.87
Emergency room	3.8% (0.19)	6.2% (0.24)	3.6% (0.19)	p = 0.43	p = 0.97	p = 0.50
Ambulatory clinic or MD office	8.3% (0.28)	18.6% (0.39)	26.8% (0.45)	p = 0.02	p = 0.002	p = 0.17
Inpatient unit	70.7% (0.46)	55.4% (0.49)	43.5% (0.49)	p = 0.01	p = 0.002	p = 0.09
Other	16.5% (0.37)	21.1% (0.41)	26.1% (0.44)	p = 0.12	p = 0.36	p = 0.50
Age of patients seen						
0 to 1 years	26.3% (0.44)	31.8% (0.47)	34.1% (0.48)	p = 0.39	p = 0.26	p = 0.89
2 to 5 years	26.3% (0.44)	34.3% (0.48)	34.8% (0.48)	p = 0.18	p = 0.22	p = 0.98
6 to 12 years	26.3% (0.44)	36.9% (0.48)	35.1% (0.48)	p = 0.16	p = 0.11	p = 0.91

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	P-values for Percent Pairwise Comparisons Between Paired Classes			Cohen's Proportional Difference Size Calculations ² for Percentage Differences Between Paired Classes		
	%	(SD)				
13 to 18 years	48.9% (0.50)	43.4% (0.49)	44.2% (0.49)	p = 0.43	p = 0.53	p = 0.96
19 to 39 years	84.2% (0.37)	78.9% (0.41)	80.4% (0.39)	p = 0.34	p = 0.52	p = 0.91
40 to 59 years	84.2% (0.37)	76.0% (0.43)	78.3% (0.41)	p = 0.75	p = 0.31	p = 0.87
60 years and older	82.7% (0.38)	76.0% (0.43)	76.8% (0.42)	p = 0.21	p = 0.32	p = 0.96
Does not see patients	2.3% (0.15)	2.9% (0.17)	2.9% (0.17)	p = 0.81	p = 0.78	p = 1.00

p = Significance level

g = Hedges' effect size

h = Cohen's effect size

¹ Hedges' effect sizes were calculated for mean pairwise comparisons of the paired classes with a 95% confidence interval.

² Cohen's proportional difference effect sizes were calculated for the percentage pairwise comparisons of the paired classes with a 95% confidence interval.

Mean/Percent Values and Pairwise Comparisons and Effect Size Calculations of Perceived Confidence and TBI-Related Training Items by Latent Class (n=513)

Perceived Confidence and TBI-Related Training Items	Perceived Knowledge Classes				P-values for Mean Pairwise Comparisons Between Paired Classes				Hedges' Effect Size Calculations ¹ for Mean Differences Between Paired Classes			
	Low Perceived Knowledge (n=133) mean (SD)	Moderate Perceived Knowledge (n=242) mean (SD)	High Perceived Knowledge (n=138) mean (SD)		Low vs. Moderate Perceived Knowledge	Low vs. High Perceived Knowledge	Moderate vs. High Perceived Knowledge		Low vs. Moderate Perceived Knowledge	Low vs. High Perceived Knowledge	Moderate vs. High Perceived Knowledge	
Perceived Confidence												
Factor 1: Nursing Roles and Responsibilities	0.72 (0.24)	0.38 (0.26)	0.18 (0.18)		p = 0.003	p = 0.002	p = 0.004		g = 1.34	g = 2.54	g = 0.85	
Factor 2: Assessment and Treatment Procedures	0.73 (0.18)	0.55 (0.21)	0.24 (0.18)		p = 0.003	p = 0.002	p = 0.004		g = 0.90	g = 2.71	g = 1.55	
TBI-Related Training												
Frequency of care												
Patients with moderate-to-severe TBI	3.50 (1.40)	2.59 (1.36)	2.57 (1.84)		p = 0.003	p = 0.002	p = 0.96		g = 0.66	g = 0.57	g = 0.01	
Men with moderate-to-severe TBI	3.42 (1.43)	2.69 (1.66)	2.49 (1.87)		p = 0.003	p = 0.002	p = 0.50		g = 0.46	g = 0.56	g = 0.11	
Women with moderate-to-severe TBI	3.14 (1.56)	2.55 (1.67)	2.58 (1.98)		p = 0.003	p = 0.002	p = 0.96		g = 0.36	g = 0.31	g = -0.02	
Time since TBI-related training occurred, mean years	4.38 (5.67)	6.27 (6.84)	10.20 (8.66)		p = 0.16	p = 0.01	p = 0.24		g = -0.29	g = -0.79	g = -0.52	
TBI-Related Training												
Yes, ever practiced with patients with moderate-to-severe TBI	97.0% (0.17)	89.7% (0.31)	67.4% (0.47)		p = 0.02	p = 0.002	p = 0.004		h = 0.30	h = 0.86	h = 0.56	
Yes, had specific TBI-Related training	66.2% (0.47)	26.9% (0.44)	7.2% (0.26)		p = 0.003	p = 0.002	p = 0.004		h = 0.81	h = 1.35	h = 0.54	

Types of TBI-Related Training	P-values for Percent Pairwise Comparisons Between Paired Classes			Cohen's Proportional Difference Effect Size Calculations ² for Percentage Differences Between Paired Classes		
	% (SD)	% (SD)	% (SD)	h = 0.38	h = 0.49	h = 0.10
Undergraduate or graduate education	16.5% (0.37)	5.0% (0.22)	2.9% (0.17)	p = 0.003	p = 0.57	p = 0.002
In-services, workshops, or continuing education	61.7% (0.49)	22.3% (0.42)	6.5% (0.25)	p = 0.003	p = 0.004	p = 0.002
Other	11.3% (0.32)	5.8% (0.23)	1.4% (0.12)	p = 0.12	p = 0.004	p = 0.002
Location of TBI-Related Training						
Poster sessions, mini seminars, or short in-services	41.4% (0.49)	12.8% (0.34)	4.3% (0.21)	p = 0.003	p = 0.03	p = 0.002
Conferences or workshops (half- or full-day)	48.9% (0.50)	15.7% (0.37)	3.6% (0.19)	p = 0.003	p = 0.004	p = 0.002
University course taken after completion of degree	2.2% (0.15)	0.40% (0.06)	2.2% (0.15)	p = 0.17	p = 0.24	p = 0.97

p = Significance level

g = Hedges' effect size

h = Cohen's effect size

¹ Hedges' effect sizes were calculated for mean pairwise comparisons of the paired classes with a 95% confidence interval.² Cohen's proportional difference effect sizes were calculated for the percentage pairwise comparisons of the paired classes with a 95% confidence interval.