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Original article

Evaluation of the simplified therapeutic intervention scoring system: Chinese version

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ABSTRACT

Objective: To prepare the Simplified Therapeutic Intervention Scoring System (TISS-28) to measure nursing workload in Intensive Care Units in Guangdong Province of China.
Methods: A non-experimental descriptive study was conducted in the intensive care units in the Province. TISS-28, TISS-76, Acute Physiology and Chronic Health Evaluation (APACHE II) were all measured.
Results: There were significant positive correlations between TISS-28 and APACHE II ($n = 91$, $r = 0.432$, $p < 0.001$), TISS-76 scores ($n = 83$, $r = 0.764$, $p < 0.001$). A significant difference was found between the mean TISS-28 score in the first day of the intensive care stay and the last day (30.76 ± 6.86 vs 24.67 ± 5.48, $p < 0.001$). A significant intra-class correlation was found between TISS-28 scores collected by the researcher and research associates (ICC = 0.959, $p < 0.001$).
Conclusion: The reliability and validity of TISS-28 were shown in Chinese intensive care units. It is a practical tool for estimating the nursing workload and providing opportunities to compare the data between intensive care units in different facilities. The TISS-28 Chinese version is recommended to guide the allocation of nursing manpower in Chinese intensive care units.

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Implications for clinical practice

- The psychometric properties of TISS-28 Chinese version were consistent with those reported in the English version and provided evidence that it was a valid and reliable measure of nursing workload in intensive care units in China.

Nursing shortage is becoming a major healthcare issue in Chinese intensive care units (ICUs). The Chinese Construction and Management Guide for ICUs recommends the bed to nurse ratio (static structure indicator, not the nurse to patient ratio) should be set in the interval from1:2.5to1:3 (Guan, 2006). The results from the survey conducted by the Department of Health of Guangdong Province in 2008 revealed that 49% of general adult ICUs in tertiary hospitals were understaffed with the bed to nurse ratio being lower than 1:2.5 (Peng and Li, 2009), despite the fact that the Chinese standard of nurse staffing is already lower than the British (Bray, Wren et al., 2010) and American recommendations (Hartigan, 2000).

The nursing workforce should be viewed as a way of maintaining quality of care in ICUs rather than as a major financial burden (Buchan, 2000). Although nursing staff costs were significant, the potential savings associated with preventing adverse events are far greater (Rothschild, Bates et al., 2009). Accurate evaluation of the nursing workload in ICUs is necessary for planning staffing

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requirements and allocating nursing human resources according the patients' nursing demands. Daily documentation of the nursing workload is important in determining the cost-effectiveness of care in ICUs. In the absence of universally accepted workload measures in Guangdong Province, clinical judgment tended to be utilised when making decisions about staffing and these decisions would often be influenced by financial factors.

The Therapeutic Intervention Scoring System (TISS) was originally developed in 1974, now the worldwide use for assessing nursing workload has increased substantially. It has been recognised as a pertinent instrument of research in ICU settings for stratifying the case mix of groups of patients, for evaluation of nursing workload, for supporting studies on the use of nursing human resources and for work process and management (Reis Miranda 1997). The validation of TISS-28 (the simplified version) was tested separately in 22 Dutch ICUs (Reis Miranda, de Rijk et al., 1996), 19 ICUs in Portugal (Moreno and Morais 1997) and 86 ICUs in Spain (Castillo-Lorente, Rivera-Fernandez et al., 2000), with all showing high correlation between TISS-28 and TISS-76 (the original version).

Although the validity and reliability of TISS-28 has been examined and demonstrated as an excellent instrument in evaluating nursing workload in several large-scale studies mentioned above, little research results have been reported from China. It is necessary to test the validity and reliability in Chinese context.

Methodology

A non-experimental descriptive study was conducted to test the psychometric properties of TISS-28 Chinese version. It was divided into three phases. Ethical approval (No. 2012016) was obtained from the appropriate university authorities, informed consent was not necessary as there was no direct contact with the patients and no interference in treatment. The data collected about the patients was completely anonymous, the patients' names were coded to ensure their privacy and the information about the patients was exclusively used for this research.

Phase one: translation and content validity

After an official authorisation was obtained, the forward-backward translation method (Brislin 1970) was used to translate TISS-28. Three bilingual translators whose native language was Chinese independently translated the original English version into Chinese. The three translations were merged and analysed in detail until consensus was reached. The synthesised version was then back-translated by another bilingual translator who was born in Hong Kong and educated in English from childhood. The back-translator was a nurse who had never seen the English version of TISS-28. The author of TISS-28 verified that the original version and the retrograde translation were consistent.

Content validity was assessed by a panel of ICU nurse experts, including two clinical nursing management administrators and four clinical nurses from ICU settings. They were asked independently to rate the relevance of the items to patients' nursing demands on a 4-point rating scale (1 = Irrelevant, 2 = Little relevant, 3 = Really relevant, 4 = Very relevant) for calculating the content validity index (CVI) (Lynn, 1986; Liu, 2010).

Phase two: convergent validity and construct validity

Convergent validity (association with APACHE II) and construct validity were examined in a surgical intensive care unit (SICU) in a university-affiliated hospital with 2228-beds in Guangzhou, Guangdong Province of China. The 12-bed SICU admitted patients from general surgery, trauma, thoracic surgery, organ transplantation, orthopedics, burn unit, gynecology and obstetrics.

Measures of concepts that theoretically should be related to each other are, in fact, observed to be related to each other, means good convergent validity. As is known to all, the severity of patient's illness was significantly related to nursing workload, so the association between the APACHE II(which presents the severity of illness) and TISS-28 should be tested for the convergent validity. The consecutively admitted patients were recruited. Patients who were 18-years of age or older were included in the study. Patients were excluded from the study if they stayed in ICU less than eight hours.

The known-groups technique was adopted for construct validity, in which the instrument is administered to several groups known to differ on a certain construct. If the results obtained demonstrate statistically significant differences as expected, then the instrument is said to have a degree of construct validity (Dempsey and Dempsey, 1999). Ordinarily the patients in the ICU were in different periods of treatment, demonstrating different nursing demands. At the early stages of their ICU stay, the patients received active treatment and invasive monitoring and thus demonstrated higher nursing demands. While at the later stages, the amount of nursing interventions decreased, the patients demonstrated lower nursing demands. It is expected that the nursing workload measured by TISS-28 in the first day of the ICU stay would differ significantly from the last day. Only the data of the patients who recovered and were eventually discharged from the ICU were included to calculate construct validity.

Phase three: inter-rater reliability and criterion-related validity

Inter-rater reliability and criterion-related validity (association with TISS-76) were examined in five ICUs in Guangdong Province, in which the SICU mentioned above was not included. The five ICUs were recruited for a multi-center research study for nursing human resource allocation in ICUs. All the five ICUs were in tertiary hospitals, and medical-surgical ICUs admitting patients from all specialties except neonates.

Inter-rater reliability is used to assess the degree to which different raters give consistent estimates of the same phenomenon (Trochim, 2000). Twenty critical care nurses from the five ICUs were selected to be research associates. They were trained on how to correctly use the TISS-28. On the selected days by convenience sampling, the researcher and the 20 research associates scored the TISS-28 independently; the inter-rater reliability was examined between the researcher and the 20 research associates.

Criterion-related validity refers to the relationship of the instrument to some already known external criterions or other valid instruments (Dempsey and Dempsey 1999). TISS-76 were selected as criterion. The patients admitted into ICUs were recruited by convenience sampling, and inclusion and exclusion criteria were the same with phase two. The criterion-related validity was supported by the correlation between the TISS-28 scores and the TISS-76 scores.

Measurement

The simplified therapeutic intervention scoring system (TISS-28)

TISS-28 included 28 items, most of which were interventions carried out in ICUs. Each intervention was assigned a weight from 1 to 8 points. If the nursing-work (time) was provided, the involved items of TISS-28 had to be scored; if not, the involved items were scored "0". TISS-28 score is calculated by summing the scores for the selected items. The range of scores is from 0 to79 points, with higher

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