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Development and psychometric evaluation of the arterial puncture self-efficacy scale

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ABSTRACT

Background: Arterial puncture for arterial blood gases (ABG) analysis can be a risky, painful, difficult-to-perform procedure that is often insufficiently practised and generates stress and discomfort amongst patients and healthcare professionals. Self-efficacy is a key component in the acquisition of procedural skills. Therefore, professionals' self-efficacy in arterial puncture should be measured before attempting the procedure on real patients.
Objective: To develop and psychometrically assess a self-efficacy scale in arterial puncture.
Design: An observational cross-sectional design was used in this study.
Setting: Faculty of Education Sciences, Nursing and Physiotherapy in a higher education institution in the south of Spain.
Participants: A convenience sample of 342 nursing students entered and completed the study. All participants met the following inclusion criteria: (1) ≥18 years old and (2) enrolled in a nursing degree programme during the 2014/2015 academic year. Participants were 74% female ($n = 254$) and their age ranged from 18 to 50, with a mean age of 21.74 years (SD = 5.14).
Method: The Arterial Puncture Self-Efficacy Scale (APSES) was developed and psychometrically tested. Reliability and content validity were studied. Predictive validity and concurrent validity assessed criterion validity. In addition, principal component analysis and known-group analysis evaluated construct validity.
Results: Principal component analysis revealed the two-subscale structure of the final 22-item version of the Arterial Puncture Self-Efficacy Scale (APSES). A total Cronbach's alpha coefficient of 0.97 showed its high reliability. The APSES' content validity index was excellent (S-CVI/Ave = 0.95). Predictive and concurrent validity analysis demonstrated the good criterion validity of the tool. Supporting the APSES' sensitivity and specificity, known-groups analysis evidenced significant differences ($p < 0.001$) in self-efficacy levels between groups.
Conclusion: The APSES showed good psychometric properties for measuring self-efficacy in arterial puncture for ABG analysis.

1. Introduction

In acutely ill patients, the respiratory function must be closely monitored and the most frequently ordered laboratory test amongst those needing critical care is arterial blood gases (ABG) analysis (Andrews and Waterman, 2010). Arterial puncture is, therefore, a regularly performed invasive procedure within critical care units, emergency departments and some medical wards (Bobbia et al., 2013; Crawford, 2004). The radial artery is the most commonly chosen blood vessel to obtain a sample for ABG analysis (Dev et al., 2011). However, the radial artery puncture is not a totally safe procedure despite its accessibility, the presence of collateral circulation and the possibility to easily promote haemostasis by applying direct pressure on the area (Baskin et al., 2014; Masoorli, 2007). Indeed, arterial puncture has been associated with a risk of arteriospasm, nerve injury, pseudoaneurysm and acute compartment syndrome (Baskin et al., 2014; Bisarya et al., 2013; Dev et al., 2011; Leone et al., 2009; Masoorli, 2007). In addition, radial artery puncture is described as a very painful and difficult-to-perform procedure in which more than one attempt is usually needed to be successful (Bobbia et al., 2013; Crawford, 2004; Haynes and Mitchell, 2010; Matheson et al., 2014; Valero Marco et al., 2008), thus generating discomfort and stress in both patients and healthcare professionals (Baskin et al., 2014; Matheson et al., 2014).

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2. Background

According to Simundic et al. (2013), in Spain, as in many other countries, nurses are responsible for drawing blood samples for ABG analysis. However, training in this invasive procedure is not always offered either as part of nursing programmes or as a continuous educational resource (Kleinpell, 2006; Simundic et al., 2013). In this context, the fact that patients have actively demanded that more skilled professionals carry out the procedure (Crawford, 2004) may indicate a need for formally assessing nurses and nursing students' competence to perform arterial puncture before attempting the procedure in real patients without supervision.

Being competent in arterial puncture, as in any other clinical or procedural skills, requires individuals not only to gain knowledge and psychomotor skills in the procedure but also to achieve a certain level of self-confidence in their capabilities to carry it out (Franklin and Lee, 2014; Hernández-Padilla et al., 2014). Practice is considered a booster for self-confidence and a paramount element in the acquisition of a particular competence (Chesser-Smyth and Long, 2013; Hernández-Padilla et al., 2015; McCaughey and Traynor, 2010; Oh et al., 2015). Nonetheless, Augustine and Kahana (2012), Dehmer et al. (2013) and Meyers et al. (2011) have reported that opportunities to practise arterial puncture throughout their formal training are scarce. Consequently, students are not highly confident they can successfully perform the procedure (Augustine and Kahana, 2012; Dehmer et al., 2013).

In accordance with Bandura's theory, self-efficacy is defined as someone's beliefs in how capable he or she is to effectively carry out a particular task (Bandura, 2006). When high self-efficacy is perceived, individuals' motivation and cognitive resources are activated and the likelihood of attempting to perform a certain activity is greater than if self-efficacy is low (Bandura, 1997; Orgun and Karaoz, 2014; Roh and Issenberg, 2014). In fact, low self-efficacy is often understood as a barrier to effectively executing the tasks involved in the activity that must be carried out (Hernández-Padilla et al., 2014, 2015).

Measuring participants' self-efficacy before and after a training session on arterial puncture for ABG analysis could provide very useful information about students' learning needs and the effectiveness of the educational intervention used (Brannagan et al., 2013). Actually, various studies have measured medical students' self-confidence in performing arterial puncture with the intention of exploring the effectiveness of different training methods or the appropriateness of an educational programme's content (Augustine and Kahana, 2012; Dehmer et al., 2013). However, the tools used to measure students' self-confidence in these studies were not validated and, to the best of our knowledge, no self-efficacy scales in arterial puncture have been developed, validated and published. This contributes, in general, to between-study heterogeneity and may limit the validity of authors' conclusions in relation to self-efficacy (Franklin and Lee, 2014).

The aim of this study was to develop and psychometrically assess a self-efficacy scale to measure nursing students' confidence in their own capabilities to effectively perform arterial puncture for ABG analysis.

3. Methods

3.1. Study design and participants

An observational cross-sectional design was used in this study. A convenience sample of 342 nursing students was recruited from a southeastern Spanish university. All participants met the following inclusion criteria: (1) ≥18 years old and (2) enrolled in a Nursing degree programme during the 2014/2015 academic year. Demographic data collected included age, gender, and educational level. Furthermore, information about exposure to and training in arterial puncture was gathered.

3.2. Ethical considerations

This study received ethical approval from the Research and Ethics Committee of the institution where it was carried out. In order to avoid influencing the individuals' decision to take part in our study, all potential participants were contacted in person by the principal researcher, who was not a staff member in their Faculty. Clear information about the research project, its goals and the participants' rights was provided to all eligible students in writing. Volunteer participants were asked to complete and sign an informed consent form before enrolment. Data were treated according to the European legislation on data protection (Directive 95/46/EC of the European Parliament, 1995).

3.3. Development of the initial instrument

Following Bandura's recommendations (Bandura, 1997), students' self-efficacy was measured in terms of 'can do'. Using a response scale from 0 to 100 intended to maximise the response options. To avoid ceiling effects, gradations of difficulty were added to the scale items (Bandura, 2006).

The Arterial Puncture Self-Efficacy Scale (APSES) was developed in Spanish. Its initial version included 26 items, and it was created based on Bandura's self-efficacy theory (Bandura, 1997), the WHO guidelines on best practices in arterial blood sampling (World Health Organisation [WHO], 2010) and other authors' recommendations (Dev et al., 2011). Before piloting the first version of the APSES, a panel of 20 experts in either critical, emergency or respiratory care and procedural skills training from five different institutions critically evaluated the questionnaire. The 20 experts individually scored each item as 1 = 'not relevant', 2 = 'somewhat relevant', 3 = 'quite relevant' or 4 = 'highly relevant' for measuring self-efficacy in arterial puncture. The items' content validity index (I-CVI) for the initial version of the APSES was calculated using the method suggested by Delgado-Rico et al. (2012) and Polit and Beck (2006).

Following experts' validation, the initial version of the APSES was piloted in order to assess its reliability and temporal stability. A convenience sample of 58 students who did not participate in the main study was voluntarily recruited to pilot the scale. All participants met the same inclusion criteria as the main sample and an identical ethical protocol was followed. The participants of the pilot sample completed the initial version of the APSES twice, with a 4-week interval between assessments. This allowed the researchers to test the temporal stability of the scale by calculating the Pearson's correlation coefficient (r) between the results of these two measurements. In addition, reliability of the initial version of the APSES was explored by calculating the following three estimators: (1) Cronbach's coefficient alpha for the whole scale, (2) the corrected item-total correlation (ITC) and (3) the estimated Cronbach's alpha if a particular item was removed from the scale. The criteria to retain each particular item were (1) item's corrected ITC > 0.3, and (2) the scale's Cronbach's alpha coefficient did not significantly increase after removing that particular item.

3.4. Data analysis

Psychometric testing procedures were performed according to other authors' methods and recommendations (Coaley, 2014; Delgado-Rico et al., 2012; Furr, 2014; Polit and Beck, 2006). Data analysis was carried out with IBM® SPSS® version 21 for Mac®.

3.4.1. Readability and understandability

The Flesch–Kincaid tool in Microsoft Word® 2011 for Mac® helped to measure the readability and grade level of the APSES. To test the understandability of the scale, five participants whose first language was not Spanish were questioned about possible difficulties found when reading the questionnaire. The completion time of the APSES was also registered.