

ORIGINAL RESEARCH

Nursing students blood pressure measurement accuracy during clinical practice

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ABSTRACT

Background: Blood pressure measurement is a complex skill to master and we sought to determine whether nursing students could measure blood pressure accurately on patients during their first clinical placement. We also examined whether clinical facilitator's subjective rating of nursing student's competence and confidence was related to blood pressure measurement.

Methods: First year nursing students (n = 105) blood pressure measurement was determined at the end of 40 hours of clinical placement. Clinical facilitators (n = 17) assessed blood pressure accuracy of the students using a double-headed stethoscope on clinical patients and rated the student's confidence and competence levels in blood pressure measurement across the clinical practicum.

Results: Bland Altman plots revealed that there was no systematic bias and that that majority of student's blood pressure readings were within ± 4 mmHg of the clinical facilitators. Blood pressure measurement was not significantly different between students and clinical facilitators (systolic: $p = .29$; diastolic: $p = .96$). Statistically significant correlations between clinical facilitator's ratings of student confidence, competence and blood pressure accuracy were found.

Conclusions: These findings show that blood pressure accuracy in nursing students during their first clinical placement is high. Clinical facilitators can also correctly assess student's blood pressure accuracy using subjective ratings of competence and confidence, which may be sufficient to determine clinical proficiency.

Key Words: Blood pressure, Clinical skills, Nurse education, Students, Competence, Confidence

1. INTRODUCTION

Clinical skills are the foundation of nursing practice and, within pre-registration nursing programs; the implementation of strategies to ensure that students are clinically competent at registration is a priority for educational providers, but often problematic to achieve.^[1] Blood pressure (BP) measurement is a fundamental clinical skill that is frequently performed by registered nurses and one considered technically challenging to master for nursing students.^[2] Accuracy is imperative for patient health assessment and for informing clinical decision-making^[3] and it is, therefore, essential that nursing

students are taught to perform the skill correctly.^[4] Therefore, the focus of this study was to determine whether nursing students performed BP measurement accurately during their first clinical practice placement. It further explored whether associations existed between clinical facilitator's ratings of student competence and confidence and BP measurement accuracy in nursing students. In doing so, this study highlights the important role of the clinical facilitator in assessing BP measurement and situations in which clinical assessment can be most valuable.

Manual BP measurement using the auscultatory method is

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a complex psychomotor skill which necessitates considerable practise by nursing students to achieve competence.^[2] Due to its importance in health assessment and treatment planning across a range of healthcare settings, BP measurement is typically taught early within pre-registration nursing curricula.^[5] Educational methods used to teach BP measurement comprise a variety of pedagogical approaches. These include: demonstration and re-demonstration in the clinical laboratory,^[6] simulation-based learning using high, medium and low-fidelity manikins,^[7] and e-learning and multimedia resources, which may complement practical-based skill training.^[8] While students may vary in their demonstrated level of clinical skills competence prior to clinical placement, the opportunity to practise clinical skills during these placement experiences is a valuable, and necessary learning strategy.^[9]

Research examining BP measurement skills acquisition, has focused predominantly on knowledge,^[5, 10, 11] measurement technique,^[10, 12, 13] student experience^[9] and teaching and learning strategies.^[2, 7, 14] It could be argued, however, that BP measurement accuracy is critical, especially as it relates to patient assessment, safety and decision-making. There is a paucity of research examining nursing student's BP measurement accuracy. While many researchers have investigated causative reasons for inaccuracy, surprisingly, most have not determined the veracity of the BP reading. Accordingly, this study examined the BP measurement accuracy in first year nursing student in their first clinical practice experience.

Importantly, a factor which must be considered in terms of influencing clinical skill development is the student's level of self-confidence which can be described as an individual's recognition of his or her abilities and belief on one's abilities to accomplish a goal.^[15] It is recognised that self-confidence is essential requirement for nursing practice and that students with self-confidence are more likely to achieve their clinical goals.^[15] Linked closely with the concept of confidence is competence. Defined as "the application of knowledge and interpersonal, decision-making and psychomotor skills in performance of a task or implementation of a role",^[1] it can be suggested that BP measurement accuracy requires both competence and confidence. Therefore, these two concepts are important in clinical skills and teasing out the implications on the measurement of BP, which is a fundamental clinical skill in early pre-registration training may assist in determining student mastery and ultimately accuracy of BP measurement.

Effective supervision and student support in the clinical environment has been widely recognised in the literature as an integral requirement for effective learning.^[16] In Australia, clinical facilitators, who are registered nurses employed by

universities to support students in clinical practice, are instrumental in supporting and assessing the performance of nursing students while on placement.^[17] Internationally, this group is similar to clinical instructors, clinical assessors, clinical educators, preceptors and mentors.^[18] Although differences exist regarding the exact remit of and context in which these roles are performed, they share the common goal of facilitating student learning and skill development in the practice settings. This is done through the provision of support, supervision and the identification of clinical opportunities that promote the theory-practice link. Due to the known difficulties nursing students have acquiring the skill of BP measurement^[9] clinical facilitators will typically focus on supervising students as they perform it, as well as verifying the reading. This support is of particular importance for first year nursing students who need to achieve competence and confidence when performing fundamental clinical skills, such as BP measurement. Furthermore, this will assist in providing foundations, for example in the form of manual dexterity and psychomotor fluency, required for more complex skill development.^[19]

Purpose of the study

An important but unexplored area of BP measurement skill acquisition by nursing students is methods by which clinical facilitators can determine BP measurement accuracy. Nursing student's self-reported competence in clinical skills has been shown to be related to clinical practice supervision.^[20] It has been previously identified that student's self-reported confidence and competence in BP measurement may impact on their ability to accurately measure BP in clinical laboratory situations.^[21] As an a priori, this suggests that clinical facilitators may be able to determine BP measurement accuracy from determination of student's competence and confidence. Therefore, identifying the most effective ways in which this can be achieved may minimise time spent supervising students who demonstrate BP measurement competence, thereby increasing time available to support to nursing students who have not achieved this. The primary aim of this quantitative study was, therefore, to determine BP measurement accuracy of pre-registration nursing students. A further objective was to detect any associations between clinical facilitator's ratings of student competence and confidence levels and accuracy of BP measurements.

2. METHODS

2.1 Setting and participants

The study was conducted in a nursing faculty at a large Australian university. Participants (n= 105) comprised first year pre-registration students. Participants were assessed by clinical facilitators (n = 17) during their clinical practice (40

hours) (see Table 1 for demographic details). Thirty-five nursing student participants disclosed that they had been trained previously in BP measurement technique. Of these, 20 reported they had previous experience in BP measurement, although this experience was limited and had not taken place in the hospital setting and therefore, was unlikely to impact on this study findings.

2.2 Ethical considerations

Participation was voluntary and approval for the study was granted by the University's Human Research Ethics Committee (Protocol No. 13490). Students were informed that participation or a decision to withdraw from the study would not affect academic progress. Facilitators were also reassured that withdrawing from the study would not affect future employment within the University. Codes were used on questionnaires to ensure anonymity and maintain confidentiality.

2.3 Study design

To achieve the study aim and objectives, an exploratory quantitative research design was employed.

2.4 Procedures

Participants underwent at least four hours of on-campus BP-specific instruction during the 13-week semester after which they were exposed to a range of BP measurement opportunities during a 40-hour clinical placement in a hospital setting. Participants were taught theory in lectures and tutorials and practised BP measurements using the auscultatory technique on student peers and human patient simulators (Nursing-Anne Vital Sim™) in clinical laboratory classes. They were also provided with opportunities to independently practise BP measurement in clinical laboratories outside class hours.

Table 1. Participant demographics

| | Nursing students (n = 105) | Clinical facilitators (n = 17) |
|---|----------------------------|--------------------------------|
| Age (years) - mean (SD) | 26.6 (7.6) | 50.5 (10.2) |
| Female | 77 (88.5%) | 15 (88.2%) |
| Education - highest attained | | |
| Higher School Certificate | 25 (24.5%) | – |
| Bachelor degree | 62 (60.8%) | 7 (41.2%) |
| Master degree | 10 (9.8%) | 4 (23.5%) |
| Other | 5 (4.9%) | 6 (35.3%) |
| Registered nurse duration (years, SD) | – | 24.4 (11.3) |
| Clinical facilitators experience (years, SD) | – | 9.5 (8.8) |

Note. Key: Other refers to nursing certificate, post-registration certificate, Graduate Certificate or Graduate Diploma degree

During the 40-hour clinical placement, participants were supervised by a clinical facilitator, who also conducted a single formal assessment of each participant's BP measurement accuracy at the end of the clinical placement. These BP assessments occurred within the final two days of the clinical placement and timing was determined by the student in consultation with the clinical facilitator. Participants selected a patient with unknown BP and, after obtaining verbal consent, BP was measured simultaneously with the clinical facilitator, using a double-headed stethoscope. During the procedure facilitators refrained from providing verbal or physical prompts.

2.5 Data collection

Participants and clinical facilitators independently documented their BP readings. Immediately following this assessment of BP, student participants completed a questionnaire related to their level of confidence and competence during

the clinical practicum. The 13-item participant questionnaire had been developed for another study^[21] and contained eight items pertaining to the participant's self-rated level of clinical competence measuring BP manually using the auscultatory method. A further five items related to self-rated levels of confidence. Using five-point Likert scales, participants were asked to select one response to each item to indicate their level of agreement (1 = very difficult to 5 = very easy, and 1 = strongly disagree to 5 = strongly agree). The clinical facilitators at the same time completed a two-part question rating the student's confidence and competence in BP measurement. The first part rated the student's confidence in BP measurement and used a five-point Likert scale (1 = not at all confident to 5 = extremely confident), and the second part of the question rated the student's competence (1 = poor to 5 = excellent) when performing BP measurement during the entire 40-hour clinical placement. Additionally, student participants recorded the number of times they practiced BP

measurement during the 40 hours of clinical placement (categories 0-5, 6-10, 11-20, 20+) which was used to determine if this was associated with BP measurement accuracy.

2.6 Data analysis

Data are presented as means with standard deviations and frequencies, unless otherwise stated. To evaluate the level of agreement between the clinical facilitator's and student's BP readings we used the Bland-Altman method.^[22,23] Bland-Altman plots provide insights into systematic bias and use a graphical representation of the two measurements (clinical facilitators and students BP readings) which allows for a visual judgement of the two measurements level of agreement, especially outliers.^[24] The Bland Altman plots have an x axis which represents the average of the two measurements (facilitators and students BP readings) and y axis which is the difference between the two measurements. For interpretation, a horizontal line represents the level of bias and two exterior horizontal lines express the 95% limits of agreement in which 95% of the difference between the measurements are positioned, and calculated as ± 1.96 times standard deviations. The BP accuracy was calculated as the difference in systolic and diastolic BP between the clinical facilitator and participants blood pressure (mmHg) measurements when assessment was conducted at the end of the clinical placement. Blood pressure accuracy scores that were negative (*i.e.* clinical facilitator BP readings were less than the nursing students) were transformed to positive values for correlational analyses. A Mann-Whitney U test was used to compare student participants and clinical facilitator's confidence scores related to the BP measurement. In addition, facilitators' ratings of participants' confidence and competence were compared using a Mann-Whitney U test of two stratified groups: 0-3 mmHg vs. 4 mmHg and above, for systolic and diastolic BP values. Systolic and diastolic BP readings that were within or equal to 4 mmHg of the actual BP measurement were considered to be clinically relevant^[25] and this was selected as the cut-off point. To determine if correlations existed between participants and clinical facilitator's confidence and competence ratings vs. BP, Spearman's rank-order correlation was used. Spearman's rank-order correlation was used to assess any association between BP accuracy (difference between clinical facilitator and student) and the number of times BP was practiced during the 40 hours of clinical placement. Cronbach's alpha was employed on the student participant 8-item confidence sub-scale and 5-item competence sub-scale to determine internal consistency reliability with alpha coefficients >0.7 considered acceptable.^[26] Statistical significance was set at $\alpha < 0.05$ (two tailed) for all analyses. Data analysis were performed using the Statistical Package for the Social Sciences (SPSS) for Windows version

21 (SPSS Inc, Chicago, IL, USA).

3. RESULTS

3.1 Blood pressure

Bland Altman graphs revealed that the average BP measurement difference between students and clinical facilitators were 0.73 mmHg and 0.02 mmHg for the systolic and diastolic BP readings, respectively (see Figure 1a and 1b). The 95% limits of agreement were ± 13.9 and 8.5 mmHg for the systolic and diastolic BP readings. A total of 32 and 17 students had BP differences of greater than 4 mmHg from the clinical facilitators for the systolic and diastolic readings, respectively. Of these, there were 9 students which had greater than 4 mmHg difference with the clinical facilitator in both systolic and diastolic BP readings. As such, the majority of student's BP measurements were considered clinically acceptable.

As revealed visually in the Bland Altman plots there was good agreement between the nursing students and clinical facilitators BP measurements. The average BP measurement were not significantly different between nursing students (systolic: 122.0 [SD \pm 18.5]; diastolic: 67.2 mmHg [SD \pm 13.2]) and the clinical facilitators (systolic: 122.7 [SD \pm 19.0]; diastolic: 67.0 mmHg [SD \pm 12.6]; systolic: $p = .29$; diastolic: $p = .96$).

We also compared the number of times BP measurement was practiced over the 40-hours of clinical practicum and compared clinical facilitator and student BP (BP accuracy; see Table 2). Moreover, the number of times BP measurement was practiced (grouped into bands: 0-5, 6-10, 11-20, 20+ times) was not correlated with the student's systolic or diastolic BP (all $p > .05$).

3.2 Questionnaires

Strong internal consistency was confirmed in the nursing student's questionnaire with Cronbach alpha in the acceptable range (confidence sub-scale: 0.82 and competence sub-scale: 0.91 respectively).

Participant's self-reported ratings of confidence and competence levels performing BP measurement were determined by correlating the aggregated confidence score (out of a possible total score of 25) against eight items of self-reported competence. Statistically significant correlations were found for each item suggesting that participants with greater confidence may have exhibited higher levels of self-reported competence in the BP measurement (all $p < .01$; see Table 3). In contrast, no significant associations were found between systolic BP accuracy scores (difference between the clinical facilitators and nursing student's BP readings) and partici-

participant's self-reported aggregated confidence and competence (confidence: $r_s = -0.08$, $p = .45$; competence: $r_s = -0.03$, $p = .74$) and diastolic difference scores and self-reported competence ($r_s = -0.11$, $p = .30$). A significant association,

however, was detected between diastolic accuracy and confidence ($r_s = -0.21$, $p = .03$) but the level of association was weak.

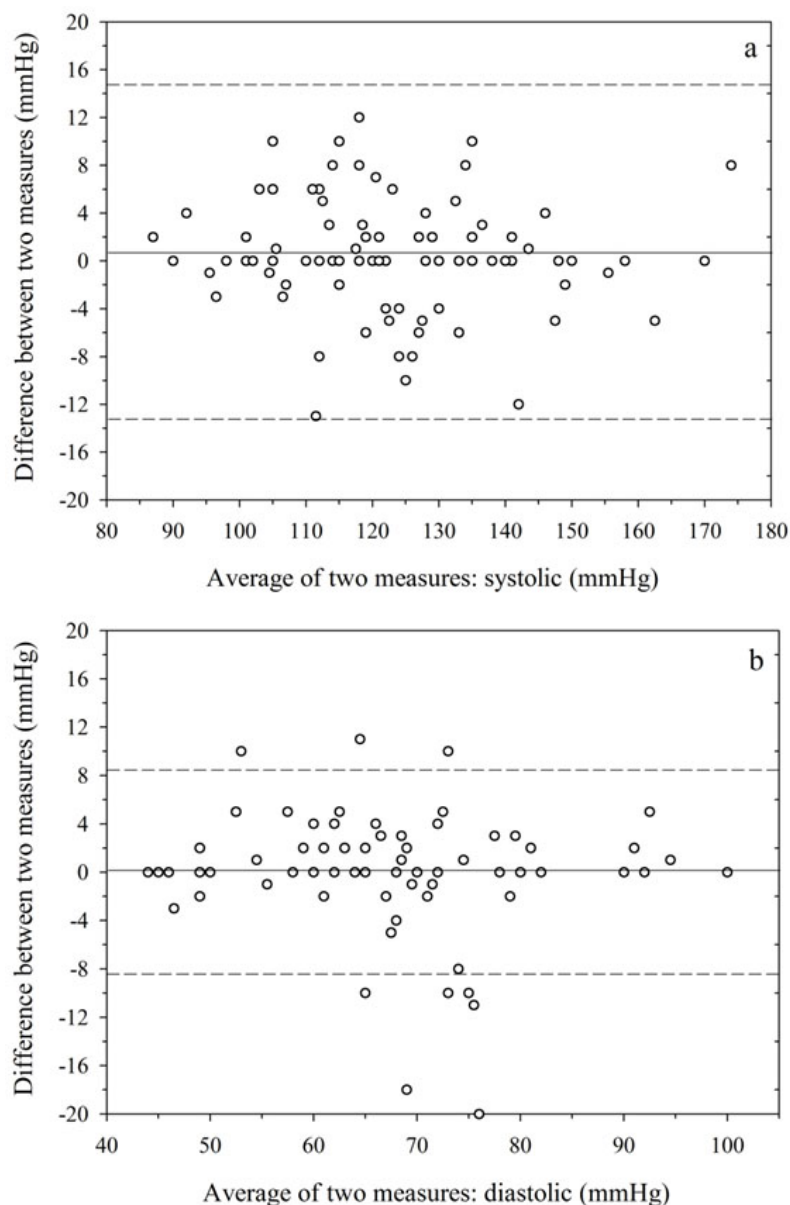


Figure 1. Bland-Altman plots of the clinical facilitator and student systolic and diastolic blood pressure measurements. The x-axis represents that average of the two measurements and the y-axis represents the difference between the clinical facilitators and students blood pressure measurements. The solid horizontal line represents the average difference between the two measurements (systolic: 0.73, diastolic 0.02 mmHg), and the two dashed lines represent the 95% level of agreement (systolic: -13.21 to 14.68, diastolic -8.47 to 8.51 mmHg).

There were statistically significant correlations between clinical facilitator's ratings of the confidence and competence of participants during the BP measurement assessment and BP accuracy, except between confidence and diastolic BP accuracy (see Table 4). The negative association showed that

when student's confidence was low, BP accuracy, determined using the difference between the BP reading of the clinical facilitator and the students reading, was poor and the reciprocal as well, high student confidence was related to small differences in BP readings with the clinical facilitators.

Table 2. Frequency of nursing students' blood pressure practice times and systolic and diastolic blood pressure accuracy

| No. of times BP practiced | Frequency (%) | Student systolic mean (SD) | Student diastolic mean (SD) | p value systolic | Facilitator systolic mean (SD) | Facilitator diastolic mean (SD) | p value diastolic |
|---------------------------|---------------|----------------------------|-----------------------------|------------------|--------------------------------|---------------------------------|-------------------|
| 0-5 | 41 (39.8) | 119.7 (19.5) | 64.0 (10.7) | 0.80 | 120.8 (20.9) | 64.3 (10.4) | 0.90 |
| 6-10 | 30 (29.1) | 125.6 (13.5) | 69.6 (10.2) | 0.96 | 125.8 (12.2) | 69.3 (10.2) | 0.93 |
| 11-20 | 18 (17.5) | 118.5 (20.2) | 64.6 (13.1) | 0.93 | 119.1 (19.6) | 64.9 (12.8) | 0.95 |
| 20+ | 14 (13.6) | 120.6 (19.4) | 74.9 (19.5) | 0.92 | 121.4 (20.0) | 73.4 (20.3) | 0.84 |

Table 3. Correlation matrix of nursing student's self-rating of confidence against competence items

| | Able to locate radial artery | Able to palpate the radial artery | Able to palpate the brachial artery | Able to hear Korotoff sounds | Able to identify the systolic measure | Able to identify the diastolic measure | Able to control the deflation of the cuff | Able to accurately obtain the BP |
|------------|------------------------------|-----------------------------------|-------------------------------------|------------------------------|---------------------------------------|--|---|----------------------------------|
| Confidence | $r_s = 0.217$ $p = .004$ | $r_s = .204$ $p = .007$ | $r_s = .232$ $p = .002$ | $r_s = 0.481$ $p = .004$ | $r_s = .589$ $p < .001$ | $r_s = .474$ $p < .001$ | $r_s = .421$ $p < .001$ | $r_s = 0.435$ $p < .001$ |

Table 4. Spearman's rank-order correlation between clinical facilitator's rating of student confidence and competence in measuring blood pressure against systolic and diastolic blood pressure accuracy scores

| | SBP accuracy | DBP accuracy |
|------------|--------------|--------------|
| Confidence | -0.324** | -0.169 |
| Competence | -0.327** | -0.225* |

Note. * $p < .05$, ** $p < .01$, SBP = systolic blood pressure; DBP = diastolic blood pressure.

Blood pressure accuracy scores were stratified into the most, and least accurate (best scores: 0-3 mmHg vs. least accurate scores: 4 or more mmHg) to compare how the facilitators rated participant's confidence and competence. Several significant differences were observed between the BP accuracy groups with facilitators overall rating higher confidence and competence scores in participants with the most accurate BP scores (see Table 5).

Table 5. Clinical facilitator ratings of student's confidence and competence when comparing the most accurate (0-3 mmHg) and least accurate (4 or more mmHg) blood pressure accuracy score groups

| Blood pressure | Facilitator's rating | U | p |
|----------------|----------------------|-------|------|
| Systolic BP | Confidence | 881.5 | .022 |
| | Competence | 922.0 | .052 |
| Diastolic BP | Confidence | 588.0 | .087 |
| | Competence | 514.5 | .018 |

4. DISCUSSION

This study sought to identify pre-registration nursing student's BP measurement accuracy during clinical practice and whether associations existed between clinical facilitators rat-

ing of student's BP measurement competence and confidence and the BP measurement accuracy of the students. Blood pressure measurement in first-year pre-registration nursing students was chosen as it is a complex psychomotor skill in which it is necessary to attain competency early in pre-registration nursing programs.^[2] There are, however, a broad range of other clinical psychomotor skills in which nursing students must also acquire and, like BP measurement, many of these are practised in clinical settings with the support of clinical facilitators. To date, there is a dearth of national, or international-level, standardised methods to determine nursing student's clinical skill competence and accuracy, especially in clinical settings, and debate is ongoing about how best to teach and assess these clinical skills.^[1,7] Accordingly, this study analysed issues which could potentially be used as indicators of BP measurement accuracy, as an exemplar of clinical skills more broadly.

An important finding of this study was that the majority of nursing students were able to measure BP accurately, when compared to clinical facilitator BP measurement scores. Bland Altman plots were constructed and revealed that there did not appear to be systematic bias in the measurement differences and that student precision with BP measurement at the end of their first clinical practicum was generally good. Bland and Ousey (2012) contend that achieving competence on manual BP measurement skills requires considerable practise, although they do not expand on what this comprises in terms of duration or intensity. In the current study there were no significant associations between the number of times nursing students' practised BP measurement and measurement accuracy. This suggests that 4 hours of clinical instruction supported by 40 hours of clinical placement, during which there are opportunities to practise BP measurement, is suf-

ficient to achieve accuracy. Therefore, it may be useful for nursing and other healthcare educators when planning clinical skills teaching timetables and curricula to consider that there may be a capacity point whereby skill acquisition will not improve until students engage in clinical practice.

A novel finding from the study was that clinical facilitators may be able to reasonably estimate BP accuracy based on their assessment of their assessment of participant's level of competence and confidence when performing the skill. The associations with systolic BP were modest and were weak with diastolic BP. This exploratory finding requires further study.

Although it is not recommended that this method of determining BP measurement accuracy is used as a substitute for traditional methods of assessment for every student, it may minimise time spent by the facilitator closely monitoring capable students performing this skill or repeatedly verifying the measurements they obtain. Adopting this assessment method may also ameliorate the need for patients to be subjected to repeated BP measurement by nursing students and facilitators, thereby minimising unnecessary discomfort and potential anxiety. It may also provide scope for clinical facilitators to maximise the efficiency in which their time is spent supporting skills development. For example, more time could be spent with students not competent in the particular skill or through the promotion of other learning activities aimed at developing clinical proficiency and skill development in other areas.

Interestingly, study findings revealed that nursing students did not report confidence and competence levels that were commensurate with their BP measurement accuracy. The lack of correlations between nursing student self-reported confidence/competence and BP accuracy suggests that students were not able to accurately determine their BP proficiency. These findings confer with those reported by Baillie and Curzio (2009) from their survey of first year nursing students' experiences of learning BP measurement. These authors found that although overall perceived levels of self-confidence and accuracy increased with experience, some students' levels of confidence remained low despite increased practise.

In contrast, nursing students appear to have an association between confidence and competence items related to BP measurement (see Table 3). This may be problematic as students' level of self-reported confidence may be high and they consider their competence to be high. This, however conflicts with their level of BP accuracy which was not associated confidence or competence. It may be that in first year nursing students understanding of clinical skills is not

sufficiently refined to ascertain their true level of competence at this early stage of their training.

The frequency in which nursing students practise BP measurement skills, both during the semester and while on clinical placements, may influence student confidence and competence ratings and potentially BP measurement accuracy. This, however, was not demonstrated in this study. Clinical facilitators who identify students as lacking confidence/competence should provide adequate supervision to enable students to develop the skill as well as sufficient opportunities to practise in clinical simulation laboratories prior to embarking on clinical placement.

Importantly, it has been shown that nursing student's self-rated confidence and accuracy in BP measurement improves during their first clinical placement.^[9,21] For example, Gordon *et al.* (2013), who previously compared students who underwent specific BP-related simulation-based learning with those who underwent conventional BP tuition, found that student exposure to clinical environments affects their perception of confidence and competence of BP measurement equally, irrespective of the method in which they were taught the skill. This is highly relevant as approximately 30% of student participant's BP measurements in this study were not found to be clinically acceptable (> 4 mmHg from the clinical facilitators). This highlights the importance of exposing nursing students to opportunities to practice clinical skills such as BP measurement, while on clinical placement and for facilitation of these learning opportunities to be considered a priority by educators.

The amount of BP instruction is also likely to influence nursing students' confidence and competence.^[11,12] It has been reported that improvement in BP technique and accuracy occurs when supplementary education is provided following basic BP instruction. For example, Ballard *et al.* (2012) reported that one hour of additional teaching significantly improved nursing students' ability to measure BP accurately, which confirmed similar earlier findings reported by Brokalaki *et al.* (2008). Interestingly, however, there does appear to be a saturation point or clinical learning ceiling whereby excess tuition does not improve clinical competence. This reiterates the importance of clinical skill consolidation in the clinical practice environment.

There were several limitations of this study. First, it was conducted at a single-study site, which may restrict the generalizability. Furthermore, while taught using a gold standard technique,^[27] variations in participant's BP measurement technique may have influenced the ability of the clinical facilitator to determine BP readings. For example, stethoscope diaphragm positioning over the brachial artery, BP cuff de-

flation speed, the size of BP cuff, and the placement of the stethoscope diaphragm at heart level may have impacted on the clinical facilitators' ability to measure BP accurately, thereby affecting results. Anxiety levels were not formally assessed in the study. There was a possibility that elevated anxiety was experienced in those participants with, either or a combination of, lower confidence, competence or BP accuracy. Alternatively, although not measured, it may have been that self-reported confidence and confidence may have been affected by the assessment process. It has been reported that nursing students experience anxiety and stress during clinical practice and related to clinical performance.^[28] Importantly, these must be acknowledged when considering the findings of this study.

5. CONCLUSION

Findings from this study appear to suggest that the majority of nursing students are able to accurately measure blood pressure in the clinical setting during their first clinical placement. There appeared to be no systematic bias and many of the nursing students BP reading differences were not different from the clinical facilitators which we assessed as gold standard. Findings also showed the potential value of using clinical facilitator ratings of student confidence and competence when assessing BP measurement and accuracy skills. It was revealed that simple subjective assessments can be indicative of nursing student's BP accuracy. Importantly,

this may assist with determining the amount of supervision a nursing student may require when undertaking the skill; however, this should not be used as a "one size fits all approach". Individual student factors including self-perceived confidence, competence and demonstrated clinical performance must also be considered.

To determine how clinical facilitator's time, skills and knowledge and educational expertise can be utilised most effectively to support the development clinical skills, further research is needed. Applying subjective determination of competency to a wider range of psychomotor skills in clinical practice also requires investigation to ascertain if these can be used to support or substitute traditional objective measures which can be time-consuming and are prone to errors. The ability to measure BP accurately is an important skill for all registered nurses. Nursing students need the opportunity to develop these skills as part of their pre-registration educational program in both the on-campus learning environment and clinical placement setting. Clinical facilitators and registered nurses, with whom students work, must provide adequate supervision and encouragement in supportive manner to enhance learning, engender confidence and to promote quality patient care.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare that there is no conflict of interest statement.

REFERENCES

- [1] Bloomfield J, Roberts J, While A. The effect of computer-assisted learning versus conventional teaching methods on the acquisition and retention of handwashing theory and skills in pre-qualification nursing students: a randomised controlled trial. *Int J Nurs Stud*. 2010; 47: 287-294. PMID:19762016 <http://dx.doi.org/10.1016/j.ijnurstu.2009.08.003>
- [2] Bland M, Ousey K. Preparing students to competently measure blood pressure in the real-world environment: a comparison between New Zealand and the United Kingdom. *Nurse Educ Pract*. 2012; 12: 28-35. PMID:21641869 <http://dx.doi.org/10.1016/j.nepr.2011.04.009>
- [3] Pegram A, Bloomfield J. The importance of measuring blood pressure in mental health care. *Mental Health Pract*. 2013; 16: 33-36. <http://dx.doi.org/10.7748/mhp2013.03.16.6.33.e849>
- [4] Wallymahmed, M. Blood pressure measurement. *Nurs Stand*. 2008; 22: 45-48. PMID:18274413 <http://dx.doi.org/10.7748/ns2008.01.22.19.45.c6314>
- [5] Armstrong RS. Nurses' knowledge of error in blood pressure measurement technique. *Int J Nurs Pract*. 2002; 8: 118-126. <http://dx.doi.org/10.1046/j.1440-172X.2002.00348.x>
- [6] Oermann M, Gaberson K. *Evaluation and Testing in Nursing Education*. 2006 New York: Springer Publishing Company.
- [7] Ballard G, Piper S, Stokes P. Effect of simulated learning on blood pressure measurement skills. *Nurs Stand*. 2012; 27: 43-47. PMID:23189601 <http://dx.doi.org/10.7748/ns2012.10.27.8.43.c9363>
- [8] Byrne E, Smyth S. Lecturers' experiences and perspectives of using an objective structured clinical examination. *Nurs Educ Pract*. 2008; 8: 283-289. PMID:18042434 <http://dx.doi.org/10.1016/j.nepr.2007.10.001>
- [9] Baillie L, Curzio J. A survey of first year student nurses' experiences of learning blood pressure measurement. *Nurs Educ Pract*. 2009; 9: 61-71. PMID:18585958 <http://dx.doi.org/10.1016/j.nepr.2008.05.003>
- [10] Bogan B, Kritzer S, Deane D. Nursing student compliance to standards for blood pressure measurement. *J Nurs Educ*. 1993; 32: 90-92. PMID:8388053
- [11] Torrance C, Serginson E. Student nurses' knowledge in relation to blood pressure measurement by sphygmomanometry and auscultation. *Nurs Educ Today*. 1996; 16: 397-402. [http://dx.doi.org/10.1016/S0260-6917\(96\)80044-X](http://dx.doi.org/10.1016/S0260-6917(96)80044-X)
- [12] Brokalaki H, Matziou V, Gymnopoulos E, et al. Modification of nursing students' performance in blood pressure measurement: an educational retraining programme. *Int Nurs Rev*. 2008; 5: 187-191. PMID:18477103 <http://dx.doi.org/10.1111/j.1466-7657.2007.00621.x>

- [13] McVicker JT. Blood pressure measurement - does anyone do it right?: An assessment of the reliability of equipment in use and the measurement techniques of clinicians. *J Family Repro Health*. 2001; 27: 163-164. <http://dx.doi.org/10.1783/147118901101195407>
- [14] Dickson BK, Hajjar I. Blood pressure measurement education and evaluation program improves measurement accuracy in community-based nurses: a pilot study. *J Am Acad Nurs Pract*. 2007; 19: 93-102. PMID:17300535 <http://dx.doi.org/10.1111/j.1745-7599.2006.00199.x>
- [15] Perry P. Concept analysis: confidence/self-confidence. *Nurs Forum*. 2011; 46: 218-225. PMID:22029765 <http://dx.doi.org/10.1111/j.1744-6198.2011.00230.x>
- [16] Reid-Searl K, Happell B. Supervising nursing students administering medication: a perspective from registered nurses. *J Clin Nurs*. 2012; 21: 1998-2005. PMID:22384822 <http://dx.doi.org/10.1111/j.1365-2702.2011.03976.x>
- [17] Sanderson H, Lea J. Implementation of the Clinical Facilitation Model within an Australian rural setting: the role of the Clinical Facilitator. *Nurs Educ Pract*. 2009; 12: 333-339. PMID:22578780 <http://dx.doi.org/10.1016/j.nepr.2012.04.001>
- [18] Delunas L, Rooda L. A new model for the clinical instruction of undergraduate nursing students. *Nurs Edu Persp*. 2009; 30: 377-380. PMID:19999940
- [19] Oermann M. Psychomotor skill development. *J Cont Educ Nurs*. 1990; 21: 202-204. PMID:2120294
- [20] Kajander-Unkuri S, Meretoja R, Katajisto J, et al. Self-assessed level of competence of graduating nursing students and factors related to it. *Nurs Educ Today*. 2014; 34: 795-801. PMID:24018358 <http://dx.doi.org/10.1016/j.nedt.2013.08.009>
- [21] Gordon CJ, Frotjold A, Fethney J, et al. The effectiveness of simulation-based blood pressure training in preregistration nursing students. *Simul Healthc*. 2013; 8: 335-340. PMID:24061336 <http://dx.doi.org/10.1097/SIH.0b013e3182a15fa7>
- [22] Altman D, Bland JM. Measurement in medicine: the analysis of method comparison studies. *Stat*. 1983; 32: 307-317.
- [23] Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet*. 1986; 327: 307-310. [http://dx.doi.org/10.1016/S0140-6736\(86\)90837-8](http://dx.doi.org/10.1016/S0140-6736(86)90837-8)
- [24] Bland JM, Altman DG. Comparing methods of measurement: why plotting difference against standard method is misleading. *Lancet*. 1995; 346: 1085-1087. [http://dx.doi.org/10.1016/S0140-6736\(95\)91748-9](http://dx.doi.org/10.1016/S0140-6736(95)91748-9)
- [25] Lee JJ, Sobieraj DM, Kuti EL. Student measurement of blood pressure using a simulator arm compared with a live subject's arm. *Am J Pharm Educ*. 2010; 74: 1-10. <http://dx.doi.org/10.5688/aj740582>
- [26] Streiner DL, Norman GR. *Health Measurement Scales: A Practical Guide to Their Development and Use* (3rd ed.). 2010 Oxford: Oxford University Press.
- [27] National Heart Foundation of Australia. *Guide to management of hypertension 2008*. Updated December 2010: National Heart Foundation of Australia.
- [28] Cheung R, Au T. Nursing students' anxiety and clinical performance. *J Nurs Educ*. 2011; 50: 286-289. PMID:21323251 <http://dx.doi.org/10.3928/01484834-20110131-08>