Relationships Between Pre-Clinical Summative Assessment Scores and the Clinical Performance of Physiotherapy Students

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RESEARCH ARTICLE

Relationships Between Pre-Clinical Summative Assessment Scores and the Clinical Performance of Physiotherapy Students

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AIM: Education providers need to ensure that students allocated to a clinical placement are optimised for success. The aim of this study was to determine the relationships between physiotherapy students' summative assessment scores in pre-clinical coursework and their future performance in clinical practice. **METHODS:** Selected as potential subjects were 123 students from four consecutive intakes (2010–2013) of an Australian entry-level Doctor of Physiotherapy program. Retrospective cohort summative assessment data for pre-clinical (Objective Structured Clinical Examinations [OSCEs], written examinations, and seminar presentations) and clinical practice (clinical practice scores) subjects in core areas of physiotherapy were retrieved. Clinical practice performance was assessed using the reliable and validated Assessment of Physiotherapy Practice instrument. A descriptive analysis, Pearson's correlations and multiple regressions were performed between mean pre-clinical and clinical performance scores. **RESULTS:** Assessment data from 118 students were analysed. Pre-clinical assessment scores were positively related to clinical performance: OSCE r=0.57, p<0.001; written examination r=0.39, p<0.001; seminar presentations r=0.29, p=0.012. A multiple regression model identified OSCE as an independent contributor to clinical performance scores (adjusted R^2=0.33, p<0.001). **CONCLUSION:** OSCE scores were strongly related to clinical performance and explained 32% of physiotherapy students' future clinical performance. Pre-clinical OSCE scores could provide opportunity to implement proactive support and enhancement strategies to increase stakeholder satisfaction and maintain quality placement experiences. *J Allied Health* 2020; 49(1):e13–e19.

THE VALUE OF clinical education in the allied health professions is well-recognised. Accreditation standards for registrable professions like physiotherapy require entry-level education programs to include clinical education components undertaken in authentic clinical environments.[1,2] There are increasing challenges for education providers to source and maintain good quality clinical placements including fiscal restraints, reductions in health sector staffing and changing staff profile, increasing student cohort numbers, and a proliferation of new programs.[3] While collaboration and innovation must occur to widen the placement opportunities available, the need to nurture and enhance existing quality clinical placements should not be overlooked. Finding opportunities to optimise student preparedness for clinical placements could provide a means of maximising students' ability to engage with the learning experience and provide quality client care, minimising stress to Clinical Educators (CEs) and the need for repeat placements. The ability to identify students likely to benefit from additional preparation prior to entering clinical placement or to require additional support during placement is an opportunity to proactively implement strategies to promote a successful and satisfying clinical practice experience for all stakeholders.

There are several points during a student's education that can be explored as potential predictors of clinical performance. Studies have reported on the ability of admission criteria[4–8] and overall academic performance[9,10] to predict the clinical performance of allied health students. However, these measures take place either before or after the education program has been completed. This limits their utility as they do not reflect the factors that may influence a students' performance at varying points throughout the program. Summative assessments embedded within discreet coursework subjects are direct measures of the knowledge, skills, and behaviours that must be implemented in a subsequent clinical practice experience. However, there may be students who meet academic progression requirements overall but would benefit from further upskilling and enhancement prior to commencing clinical placement.

Commonly used assessment methods in health profession programs include written examinations and Objective Structured Clinical Examinations (OSCEs). There is evidence within the medical profession that OSCEs[11–19] and written examinations of multiple

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TABLE 1. Pre-Clinical Summative Assessments Completed

Core Area	Written Examinations*	OSCEs	Seminar Presentations
Cardiorespiratory	1 × 90-min SAQ	2 × 15-min stations	1 × 15-min presentation
Orthopaedics	1 × 120-min MCQ/SAQ	2 × 15-min stations	None
Neurological	1 × 120-min MCQ/SAQ	3 × 15-min stations and 1 × 30-min station	None
Musculoskeletal	1 × 120-min SAQ	3 × 15-min stations	None

*MCQ, multiple choice questions; SAQ, short answer question.

choice or extended matching questions[14,15] are significantly correlated with clinical performance. OSCE scores were reported to explain 1.9% to 39.7% of the variability in medical students' clinical performance.[11–19] The variety of clinical performance measures used is one factor that may explain the large differences in strengths of relationships identified as nine studies[11–19] used eight different methods of assessing clinical performance.

There are many similarities between education in the medical and allied health professions. However, allied health students in Australia are expected to have the ability to be independent, autonomous practitioners at the point of graduation. This is very different to the support structure in place for new graduate medical doctors. It is likely then that the expectation of students' clinical performance between the professions will also be different, which limits the generalisability of relationships identified in medical students.

Literature investigating relationships between specific coursework summative assessments and students' future clinical performance in physiotherapy is limited, as it is within the wider allied health professions.[20] One study of a Canadian physiotherapy program found no significant correlation between OSCE scores and clinical performance as measured by the Clinical Performance Instrument.[21] In contrast to this finding, single studies among dentistry,[22] dietetic,[23] and pharmacy[24] students have identified significant positive relationships between OSCE scores and clinical performance. The limited and conflicting research conducted within the physiotherapy and wider allied health professions is indicative of the need for further research in this area. The aim of the present study was to determine if relationships existed between specific coursework summative assessments used in pre-clinical coursework and the future clinical performance of physiotherapy students, employing a well-described measure of clinical performance that is valid, reliable, and widely used.

Methods

This was a retrospective cohort study. Ethics approval was obtained from the Bond University Human Research Ethics Committee (RO1733). Participants were students from four consecutive cohorts (2010–2013) of an entry-level Australian Doctor of Physiotherapy program. Participants were excluded if they had not completed the first year of the program, including all required core coursework subjects and corresponding clinical placements. Assessment data were retrieved from electronic records and archived hardcopies. Participants' data were analysed if there was complete assessment data for a core area of physiotherapy, consisting of all summative assessment scores in the pre-clinical coursework subject immediately preceding the corresponding clinical placement, and the placement's clinical performance score.

Participants completed discreet pre-clinical coursework subjects and a corresponding clinical placement in four core clinical areas of physiotherapy: Cardiorespiratory (CR), Orthopaedics (Ortho), Musculoskeletal Outpatients (MSK), and Neurological (Neuro) physiotherapy. Coursework covered in preparation for clinical placements included theory and practical skills related to the assessment and treatment of the following:

- CR: conditions involving the respiratory system, cardiac system, the acutely unwell patient, and the post-surgical patient
- Ortho: acute musculoskeletal injuries, orthopaedic surgery, and rheumatoid and osteoarthritis
- MSK: chronic musculoskeletal conditions, the spinal column, and deeper exploration of the management of acute musculoskeletal conditions
- Neuro: acute and chronic neurological and age-related conditions.

Pre-clinical coursework summative assessments investigated were the OSCE, written examinations, and seminar presentations (Table 1). The position of the assessment items within the program are described in Table 2. Total subject marks were also investigated.

The written assessments consisted either entirely of short answer questions (SAQs) or a combination of SAQs and multiple choice questions (MCQs). The written examinations aimed to assess students' theoretical knowledge of relevant anatomy, physiology, pathology, clinical reasoning, and ability to identify appropriate physiotherapy assessments and interventions. Written assessments accounted for 40–50% of students' total subject mark.

OSCEs were conducted either 1 or 2 days after the written assessments and all were delivered in the same conditions. Examiners were licensed physiotherapists, used detailed mark sheets, and were briefed on the applications of these prior to the examination. Students completed 2–3 × 15-min stations per OSCE. One OSCE

TABLE 2. First Three Semesters of the Host Doctor of Physiotherapy Program

Semester 1		Semester 2*		Semester 3*	
Principles of Physiotherapy	CR PT I	CR PT II OSCE + Written + Seminar	CR Clinical Placement APP		
	MSK PT I	MSK PT II (Ortho) OSCE + Written	Ortho Clinical Placement APP	MSK PT III (Outpatients) OSCE + Written	MSK Clinical Placement APP
				Neuro PT OCSE + Written	Neuro Clinical Placement APP

*Seminar indicates seminar presentation; Written indicates written examination.

also had an additional 30-min station at the commencement of the examination where students were required to watch and analyse video material. Each station was structured around a clinical case study and may have had marks allocated for professional conduct, communication, clinical reasoning, technique performance, and safety. OSCEs accounted for 45–50% of students' total subject mark.

Seminar presentations were utilised in one core coursework subject (CR) and required students to deliver a 10–15-minute seminar on a relevant disease or pathology. Seminars were independently marked by two assessors against a standardised rubric with criteria including quality of communication, organisation of material, content and knowledge of subject matter, use of evidence-based information, and effectiveness of delivery. The mean score of the two assessors constituted the students' allocated mark. The seminar presentations constituted 15% of the students' overall CR subject mark.

Students who met the passing standard in pre-clinical coursework progressed into the corresponding clinical placement. Participants completed a maximum of four clinical placements, one in each of CR, Ortho, MSK, and Neuro. Each clinical placement was embedded in the program and occurred within the same semester of study in which the relevant pre-clinical coursework was completed. Students were allocated to clinical placements where they spent 5 weeks, full-time, immersed in that clinical environment practicing under the supervision of a CE. CE details were not known at the time of allocation and CEs were not informed of students results in pre-clinical coursework, other than the student had met the required minimum standard.

Clinical performance was measured by the Assessment of Physiotherapy Practice (APP) instrument. The APP is commonly used by physiotherapy education programs to assess the clinical performance of students across Australia and New Zealand. The APP is a valid[25] and reliable[26] measure of clinical performance and is well described in the literature.[27] A systematic review by O'Connor et al.[28] synthesised evidence relating to the edumetric and psychometric properties of clinical performance tools used by the physiotherapy profession and awarded the APP level A evidence for validity and level B evidence for reliability and edumetric evidence. The APP measures student performance across seven domains of practice and totals 20 items. The domains of practice examined by the APP are professionalism, communication, assessment, analysis and planning, intervention, evidence-based practice, and risk management. Items are accompanied by performance indicators, a list of observable behaviours assessors can refer to, to assist in determining the standard to which an item is being demonstrated. The APP was completed by the CE formatively at the mid-point of the clinical placement and summatively at the end of the 5 weeks of placement. Final APP total scores account for 70% of students total core clinical practice subject marks. For this study, final APP total scores, and scores for each of the seven domains of practice were retrieved.

Data Management and Statistical Analysis

Retrieved raw assessment data were converted to a percentage out of 100, as is done routinely by the university to calculate weighted marks. Data were made non-identifiable. Students' mean score for each assessment type as well as total subject score were calculated and entered in the Statistical Package for the Social Sciences (SPSS) software ver. 24 (IBM-SPSS, Armonk, NY, USA) with significance set at $p<0.05$. Student data were profiled using descriptive statistics. Tests for normality were performed to identify the appropriate analyses to undertake. Pearson's correlations were calculated between independent variable mean scores (OSCE, written examination, seminar presentation, and total subject mark) and APP mean scores utilising a Bonferroni adjusted p-value of 0.0125 (0.05/4) to determine significance. Correlations were calculated between the independent variables and specific domains of the APP also utilising a Bonferroni adjustment. Strengths of correlations were based on the rating scale of Cohen[29] (Table

TABLE 3. Strength of Associations by Cohen (1988)[29]

Coefficient Value	Strength of Association
$< r < 0.3$	Weak correlation
$0.3 < r < 0.5$	Moderate correlation
$r > 0.5$	Strong correlation

3). A multiple regression analysis was performed to determine the effect of each independent assessment item on clinical performance scores.

Results

The 2010–2013 cohorts had a total of 123 students enrolled (65 males, 58 females). Five students did not complete the first year of the program. Data from 118 students met the inclusion criteria and their retrieved assessment data were analysed (62 males, 56 females).

The mean scores for each assessment item are provided in Table 4. Students performed best on the seminar presentation with a mean score of 90.54% (±6.24 SD). Written examinations had the lowest mean score of 71.88% (±6.48). The mean APP scores of raw assessment data before conversion to a score out of 100 are shown in Figure 1.

The mean scores of each coursework assessment item were significantly correlated with mean clinical performance scores as reported in Table 5. The OSCE (r=0.57, p<0.001) and total subject mark (r=0.55, p<0.001) had the strongest significant correlations. Written assessment and the seminar presentation demonstrated significant correlations of moderate and weak strength, respectively.

Correlations between coursework summative assessments and specific domains of the APP are reported in Table 6. The OSCE demonstrated significant moderate to strong correlations with all domains of the APP. Correlations ranged from r=0.36 (professionalism) to r=0.62 (intervention). The written examination showed significant weak or moderate correlations with all domains of the APP (r=0.29–0.42), except professionalism and risk management. The seminar assessment demonstrated significant weak correlations with the communication and intervention domains (both r = 0.23). Variances are displayed in decimal form in Table 6.

Analysis of the regression model determined that all assumptions of a multiple regression were met. A multiple regression model including mean OSCE, written, and seminar scores was determined to be the best fit ($F_{[3,114]}$=20.26, p<0.001, R^2_{adj}=0.33, SEE=6.88) and was a moderate predictor of APP scores. The OSCE (β=0.49, p<0.001, 95%CI 0.46–0.98) was a significant independent contributor to the relationship with clinical performance. The written examination and seminar presentation were not significant contributors to the model (β=0.09, p=0.31, 95%CI –0.11–0.36 and β=0.14, p=0.08, 95%CI –0.02–0.39, respectively).

Discussion

The aim of this study was to determine the relationships between specific coursework summative assessments and the future clinical performance of physiotherapy students. The OSCE showed the strongest correlation with students' clinical performance, although all three summative assessment items were significantly correlated with overall clinical performance. Given that an appropriately designed OSCE aims to measure students' clinical performance against a set standard of competence,[30] this is not surprising.

The OSCE investigated in the present study demonstrated a strong relationship (r=0.57, p<0.001) with students' future clinical performance and explained 32% of the variation (r^2=0.32) in students' overall performance on the APP. These findings support the assumption that performance in a pre-clinical OSCE is related to students' future performance in authentic clinical environments. They also suggest that pre-clinical OSCE scores could be effectively used as an early indicator not only of students' future overall clinical performance, but also their performance in specific domains of practice. OSCE scores were related to performance in all domains of practice. Of note, OSCE scores were strongly related to performance in the 'intervention,' 'assessment,' and 'analysis and planning' domains, where they explained 31–38% of the variation (r^2=0.31–0.38) in students' clinical performance. This suggests students with low-passing OSCE scores may benefit from enhancement in these domains prior to, or early in, placement. These findings may be influenced by the structure of the stations included in the OCSEs informing this study and the allocation of marks within individual OSCE stations. They may also be influenced by the timing of the OSCEs; OSCEs were consistently held after the written examinations.

TABLE 4. Descriptive Statistics of Mean Assessment Scores Across Core Areas

Assessment	*n*	Minimum %	Maximum %	Mean %	SD
APP	118	60.63	97.50	78.67	8.41
OSCE	118	63.12	93.01	76.91	5.81
Written examination	118	52.09	86.04	71.88	6.48
Seminar presentation	118	64.00	100.00	90.54	6.24
Total subject mark	118	60.35	89.11	74.93	5.36

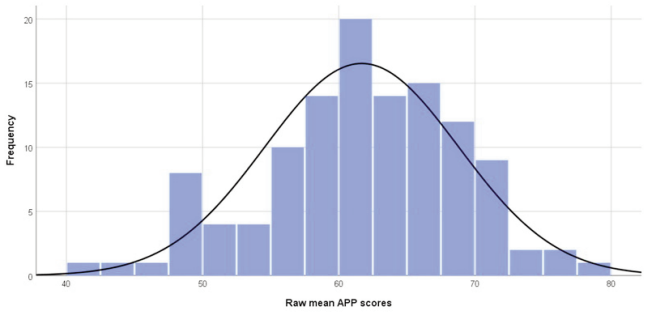

FIGURE 1. Distribution of raw mean APP scores.

TABLE 5. Relationships Between Mean Pre-Clinical Summative Assessment Scores and Mean APP Scores Across Core Areas

Coursework Assessment	*r*	r^2	*p*
OSCE	0.57	0.32	<0.001*
Written examination	0.39	0.15	<0.001*
Seminar presentation	0.29	0.08	0.012*
Total subject mark	0.55	0.30	<0.001*

*Significant finding of $p<0.0125$.

The seminar presentation demonstrated a weak relationship (r=0.29, p=0.012) with students' future clinical performance but explained only 8% of the variation (r^2=0.08) in students' overall performance on the APP. The only domains of practice significantly related to students' seminar presentation scores were the 'communication' and 'intervention' domains, both of which explained only 5% of the variation (r^2=0.05) in student performance on the APP. These correlations may have been skewed by the fact that the mean score for the seminar presentations was markedly higher than any other pre-clinical assessment. The findings are also limited by the size of the dataset for the seminar presentations, as it is utilised in only one of the four coursework subjects investigated. It should be noted that the seminar presentations investigated differed from traditional oral examinations, which have been described as "a face-to-face interaction between an examinee and one or more examiners."[31] The seminars investigated were pre-prepared presentations with only a short question-time of 2–3 minutes allotted, so comparisons with existing literature reporting on traditional oral presentations will be extremely limited.

The written examinations demonstrated a moderate correlation (r=0.39, p<0.001) with students' future clinical performance and explained 15% of the variation (r^2=0.15) in students' performance on the APP. These findings support the assumption that students' demonstration of knowledge in a written assessment is related to the students' application of that knowledge in a clinical setting. In clinical placement, students are routinely required to apply skills assessed in written format: clear and succinct communication of knowledge and ideas, analysis of case studies, identification of appropriate assessments and interventions, and identification of potential risks. There was no significant relationship between the written examination and the 'professional behaviour' or 'risk management' domains. The written assessments did not include specific ethical scenarios, which may have contributed to the lack of a significant relationship. It is also possible that the behaviours required to demonstrate adequate performance in the professionalism and risk management domains within a fluid and reactive authentic environment are difficult to draw out in a controlled written examination.

Clinical placements are increasingly becoming a precious commodity,[3] and therefore education providers should make every effort to ensure that students allocated to a clinical placement are optimised for success. The relationships identified in this study support the use of written assessments and OSCEs in physiotherapy education and confirm the assumption that the standards achieved in these assessments are an indicator of a student's expected performance in clinical practice. The strong relationship between OSCE scores and students' future clinical performance could be used as an opportunity to identify students who may benefit from positive enhancement strategies prior to the student entering the clinical environment, particularly in the assessment, analysis and planning, and interven-

TABLE 6. Correlations Between Mean Pre-Clinical Summative Assessment Scores and Mean Performance on APP Domains Across Core Areas

	OSCE			Written Examination			Seminar Presentation			Total Subject Mark		
APP Domains	*r*	r^2	*p*	*r*	r^2	*p*	*r*	r^2	*p*	*r*	r^2	*p*
Professionalism	.36	.13	<.001*	.16	.03	.09	.11	.01	.25	.31	.10	<.001*
Communication	.45	.20	<.001*	.34	.12	<.001*	.23	.05	.01*	.45	.21	<.001*
Assessment	.56	.31	<.001*	.40	.16	<.001*	.19	.04	.04	.54	.29	<.001*
Analysis & planning	.57	.32	<.001*	.42	.18	<.001*	.20	.04	.03	.56	.31	<.001*
Intervention	.62	.38	<.001*	.42	.18	<.001*	.23	.05	.01*	.59	.35	<.001*
EBP	.42	.18	<.001*	.29	.08	<.001*	.15	.02	.10	.41	.17	<.001*
Risk management	.45	.20	<.001*	.20	.04	.03	.20	.04	.03	.37	.14	<.001*

*Significant finding of $p<0.0125$.

tion domains of practice. The identification of students likely to require increased CE input provides opportunity for these students to be more closely monitored whilst on placement, and additional support offered to both student and CE in a timely and responsive way. This is important as university support for CEs has been reported as a facilitator for the provision of clinical placements.[32] Proactive learning experiences and assistance could be utilised pre-clinically as well as early in the clinical placement to maximise the chance of a successful and satisfying experience for all stakeholders. The findings of this study may be used as a foundation to justify future research into the design, implementation, and evaluation of early intervention programs to enhance clinical placement preparedness.

Strengths of this study include the use of consecutive cohorts of students and a consistent pre-clinical and clinical program of assessment. Furthermore, the APP clinical performance instrument, which is used by most physiotherapy education programs in Australia and New Zealand, has been demonstrated to be a valid and reliable assessment tool. The thorough description of the APP instrument available in the literature may enable programs to compare their clinical performance instruments to the APP and interpret the findings accordingly. A potential weakness of this study is that it was limited to a single institution. Future research on this topic should aim to recruit larger participant numbers drawn from multiple institutions and should also investigate differences in pre-clinical summative assessment format.

Conclusions

The pre-clinical OSCEs investigated in this study were found to have a strong relationship with clinical performance, explaining up to 32% of the variation in students' future clinical performance. OSCE scores were significantly related to students' clinical performance in all domains of practice and could potentially be used as a measure to identify students who could benefit from proactive strategies for enhancement prior to entry into their associated clinical placements. OSCE scores may also offer education providers the opportunity to selectively establish early support for both student and CE during clinical practice to increase satisfaction in the clinical placement experience for all stakeholders.

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