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Use of a Human Patient Simulator to Improve Physiotherapy Cardiorespiratory Clinical Skills in Undergraduate Physiotherapy Students: A Randomised Controlled Trial

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ABSTRACT

Purpose: To investigate whether additional training with a human patient simulator improves cardiorespiratory physiotherapy practice in undergraduate physiotherapy students. **Method:** A randomised controlled trial was undertaken with 50 third year physiotherapy students from James Cook University, Queensland Australia. Participants in the intervention group underwent two four hour sessions of patient simulator training in addition to their normal cardiorespiratory physiotherapy training prior to attending clinical placements. Participants in both the intervention and control groups were assessed weekly for six weeks on their clinical ability whilst on clinical placement. **Results:** Mann-Whitney was used to compare the training group with the control group. No significant difference was found between groups.**Conclusion:** This study indicates that simulation, as undertaken in this manner, does not improve clinical ability in cardiorespiratory physiotherapy. Further studies are needed to determine if more training time is required, or whether simulation must be fully integrated into the curriculum.

INTRODUCTION

Human patient simulators, or mannequin simulators, have been used in medical and nursing education for a number of years.[1-4] The use of mannequin simulators in teaching allows students to practice in a safe environment without risk to patient safety. Also, students are able to practice as often as required, the complexity of patient scenarios can be controlled, and students can develop confidence in their skills prior to patient contact.[2,4-6] The greatest success in simulator training has been achieved in the development of particular psychomotor tasks such as endoscopy, intubation, and laparoscopic techniques. Research into these psychomotor tasks showed that simulator training improves participant skills in the real world.[7-10] However, it also became evident that this training needs to be specific for each type of task, as knowledge gained in one experience does not necessarily transfer over to another experience.[11, 12]

Physiotherapists perform a number of psychomotor tasks which have the potential to put patients at risk; manual hyperinflation, suctioning, and joint mobilisations are three examples. There is little evidence to show how much practice is required to adequately train physiotherapists to safely perform these skills. As well, there has been a reduced amount of access to patient clinical situations and there is no guarantee that undergraduate students will be able to gain direct practical experience in a wide range of areas. [13] The current healthcare climate, with patients having a reduced length of stay, increased patient acuity, and justifiable concerns regarding patient safety has decreased the amount of patient contact a student may obtain.[14]

One area that mannequin simulators may be used in physiotherapy education is in cardiorespiratory physiotherapy. In many countries, physiotherapists assess and treat patients with a wide range of respiratory and cardiac conditions. It has been found that use of a mannequin simulator can reduce the amount of time a student needs to obtain competency in a skill in a clinical setting.[2] Therefore, skills could be practiced on a mannequin simulator and transferred to the clinical setting when competency is obtained, as there is some evidence that simulation can transfer into improved patient care.[15] Furthermore, mannequin simulators could improve the clinical experience for physiotherapy students, reduce the amount of clinical supervision required, save money for health services providing clinical experiences, reduce the amount of time required for physiotherapy students to become competent on a clinical placement, and protect patient safety.[14]

There are no known studies which have investigated the use of mannequin simulators in physiotherapy education for transfer of learning to a clinical situation, and few studies, in general, have investigated the use of mannequin simulators as a means for reducing the amount of time students take to become competent in a clinical setting. A systematic search of the literature by Jones and Sheppard in 2007 only identified two articles on the use of mannequin simulators in physiotherapy.[1] These two articles found inconclusive results regarding the use of a mannequin simulator and physiotherapy performance. One study found that chest percussion using a doll and a force plate improved student performance in the technique, while the other study found that physiotherapy students' confidence improved after practice in a mock intensive care unit.[16] Neither of these studies investigated whether these skills were transferred to the clinical setting. Following the same search strategy as Jones and Sheppard, an up-to-date review of the literature to May 2010 found nineteen new articles; however, none of these were physiotherapy specific. Out of the total thirty five articles, eighteen were randomised controlled trials, with the next most common research method being crossover studies (five articles), systematic reviews, and observational cohort studies (four articles of each design). None of these studies investigated skills that are used by cardiorespiratory physiotherapists.

Furthermore, calls have been made for research to investigate whether skills learned using simulation transfer to real world situations rather than concentrating on participants' perceived benefits of that training.[17,18] However, the results of simulator training in many studies, especially in the field of nursing, still use satisfaction or confidence as an outcome measure.[17,19,20] Satisfaction and confidence are poor indicators for simulation training because it does not show if the learning experience produced positive learning benefits.

Two reasons for the poor outcomes in simulation training may be the choice of research design and the time spent on simulation training. Randomised controlled trials (RCTs) are still the most common form of research design with eighteen studies out of thirty-seven. The use of randomised controlled trials is seen in the health field, and in particular in medicine, as a "gold standard' where RCTs are given greater value than other types of research. Furthermore, twenty five of the studies found used less than ten hours training with the mannequin simulators. One possible reason for this may be a lack of simulators, especially at the high-fidelity end where the simulators are extremely expensive, and therefore there is limited time students can practice techniques using the simulators. As well, simulation has been used instead of other teaching strategies, such as case studies or didactic lectures, which would have normally involved less than ten hours training, whereas simulation is a different type of training and thus requires a different approach.[21-24]

Given the lack of research into the use of simulators in physiotherapy, and particularly cardiorespiratory physiotherapy, this study explored whether the use of a medium fidelity mannequin simulator (MS), defined as a mannequin driven by a computer to allow the manipulation of physiological parameters, improves the development of physiotherapy cardiorespiratory clinical skills.[1]

Research Aims

The aims of this research were to determine whether:

1. physiotherapy students who have additional training on a mannequin simulator would score at least 8% higher on clinical placement as compared to those students who undertake a traditional learning program. Eight percent was chosen as students felt that this was a significant improvement and liable to take most students up one grade.
2. the use of a mannequin simulator would reduce by one week the time needed for physiotherapy students to become competent in cardiorespiratory physiotherapy skills on a clinical placement.
3. students with pass scores (50–64.99) in pre-clinical cardiorespiratory units would improve more with training on the mannequin simulator than those without this training.

METHOD

An experimental design was used with participants randomly allocated to either intervention or control group.

- Intervention group: those who received training using a mannequin simulator for two four-hour sessions in addition to traditional training.

- Control group: those who received no additional training beyond traditional training.

Allocation
A computer software random number generator program was used to generate the randomisation list which was kept off site by author LS. This list stated which numbers were allocating participants to intervention or control groups. Numbers were placed into opaque envelops and sealed; author AJ then distributed the envelopes to participants. This allowed AJ to remain blinded to group allocation until all data was collected.

Participants
Potential participants consisted of third year undergraduate physiotherapy students at James Cook University (JCU), Australia, who were recruited between July 2007 and July 2008. Verbal and written information regarding the aims of the study were provided and potential participants were informed that non-participation would in no way affect their progression in the physiotherapy program. They were also informed that any additional assessments used within the study could not to be used for progression within the program. Those who volunteered signed an informed consent form prior to enrolment in the study.

Traditional training involved didactic lectures, practical sessions, and tutorials in two cardiorespiratory/acute care subjects (PS2002 Physiotherapy 1 and PS3001 Physiotherapy 3) over two semesters – second semester second year and first semester third year. These two subjects had a combined total of 52 hours of lectures, 92 hours of practical classes, and 4 hours clinical experience supervised by an academic staff member. Classes covered the theoretical and practical skills required of a new graduate to practice cardiorespiratory physiotherapy techniques appropriate for the Australian healthcare system. The clinical experience involved students seeing patients in pairs and undertaking a basic assessment and treatment of stable surgical or respiratory patients. All participants in this study had completed this training five weeks prior to attending clinical placements. No participant had undertaken any formal clinical placement which occurred in the second half of third year and the first half of fourth year. The first clinical placement subject, PS3005 Physiotherapy Theory and Application 1, occurred in the second half of third year and involved students attending two, six week placements. The first half of fourth year involved students undertaking their second clinical placement subject, PS4001 Physiotherapy Theory and Application 1, which involved three, six week placements. Students would attend an acute care placement at any one of the five placement in the two subjects.

Inclusion criteria
Participants were eligible for inclusion if they had passed the cardiorespiratory subjects described earlier and were permitted to enrol in the first clinical placement subject (PS3005 Physiotherapy Theory and Application 1).

Exclusion criteria
Participants were excluded from the study if they had transferred into the Bachelor of Physiotherapy degree without completion of the JCU cardiorespiratory subjects. This allowed for standardisation of cardiorespiratory training prior to allocation to intervention or control groups.

Withdrawal
Participants were withdrawn from the study if they:

1. withdrew consent,
2. withdrew from the Bachelor of Physiotherapy degree prior to starting the cardiorespiratory/acute care clinical placement,
3. failed the first clinical placement subject (PS3005) without having completed a cardiorespiratory/acute care placement.

Intervention

The intervention group received traditional training and then they received an additional eight hours of training on a medium fidelity mannequin simulator, the Nursing Anne VitalSim (Laerdal), which allowed for moderate interaction between mannequin and the user.[1] This interaction allowed modification to lung and heart sounds as well variations to blood pressure, respiratory rate, and ECG based on the conditions and treatments being practiced.

The intervention group practiced, in pairs, assessment and treatment techniques appropriate to the given scenarios which were developed by the principal investigator (AJ) and are outlined in detail in another article.[25] In short, the scenarios represented major conditions seen in cardiorespiratory physiotherapy practice, which were validated by physiotherapy experts. Elements associated with a patient's care in hospital were reproduced, such as X-rays, observation charts, past and current medical records, and relevant laboratory tests. Attachments such as oxygen delivery devices, indwelling catheters and intravenous lines were also used as appropriate. The elements of patient care and attachments were consistent with each scenario.

The sessions were facilitated by an experienced cardiorespiratory physiotherapy clinical educator who had been trained on using the simulator. The facilitator was not involved in either the traditional training or future clinical education placements for the participants in the study.

The simulator sessions were held one week prior to the participants attending their first clinical placement. Participants were randomly allocated to set simulation session times by having their name, and the day and time pulled out of a hat. All participants in the simulation training completed the same scenarios. The participants worked in pairs, one acting as the physiotherapist and one as the voice of the patient for one scenario. They then swapped roles when undertaking another scenario. The facilitator provided prompting and feedback regarding the participants performance. This process followed the same process that occurs with clinical educators in clinical settings.

Outcome measure

The measurement tool used was the Assessment of Physiotherapy Practice (APP) version five, see Dalton et al (2009).[26] This tool is used nationally in Australia to assess physiotherapy students' performance in clinical practice. The APP assesses a number of different components (Table 1) and each component has criteria which describe an achieved level. The levels are scored on a scale of zero to four. The score for each criteria were totalled to achieve an overall competence score (CS). The scores obtained by the APP tool have been through a validation and reliability process which has shown high inter-class correlation coefficient (ICC) of 0.96 (95% confidence interval of 0.93 to 0.98).[26]

Table 1: Clinical evaluation components

Subjective assessment
Objective assessment
Interpretation from assessment findings and other resources
Appropriate intervention plan
Execution of intervention techniques
Evaluation methods
Evaluation guides patient management
Communication and rapport
Professional behaviour
Documentation
Safety
Reflective practice

Sample size

No students from JCU had yet to attend clinical placements; as a result, there was no historical data, such as the mean clinical mark or standard deviation for acute care placements available to calculate a required sample size. In discussions with experienced clinicians involved in clinical assessment, an average clinical mark was considered to be 67%. In discussions with students, they felt that being able to move up to the next grade, i.e. from 67% to 75%, was a significant difference based on educational method. At JCU a pass grade is 50- 64.9%, credit 65-74.9%, distinction 75-84.9% and high distinction 85-100%. Therefore, the sample size was calculated as 30 participants for each group (α 0.05, power 0.8) using the average mark of 67% and standard deviation of ten marks. To achieve this sample size, participants needed to be enrolled from third year physiotherapy students in two separate years (2007 and 2008).

Ethics

Ethical approval (H2384) was granted by JCU's Human Ethics Committee. Written informed consent was obtained from the participants and clinical educators wishing to participate in the study. Participants and clinical educators could withdraw from the study at any time without prejudice.

Data Collection

The cardiorespiratory/acute care placements ran for six weeks in Queensland's public hospitals, and all participants on placement were assessed by their clinical supervisor at the end of three and six weeks using the Assessment of Physiotherapy Practice (APP) tool. In addition, all participants enrolled in the study were assessed at the ends of week one, two, four, and five. This was to detect when participants became competent whilst on clinical placement and to determine whether the intervention group achieved competence one week earlier than the control group. The APP is measured out of 80 and competent is defined as achieving a score of 40 as per Dalton et al. [26]

Grades from the cardiorespiratory/acute care subjects (PS2002 and PS3001) were gathered from the participants' academic record by the principal investigator (AJ) after all study data were collected. Each participant's pre-clinical placement score was calculated by combining both grades and dividing by two to create an average percentage grade.

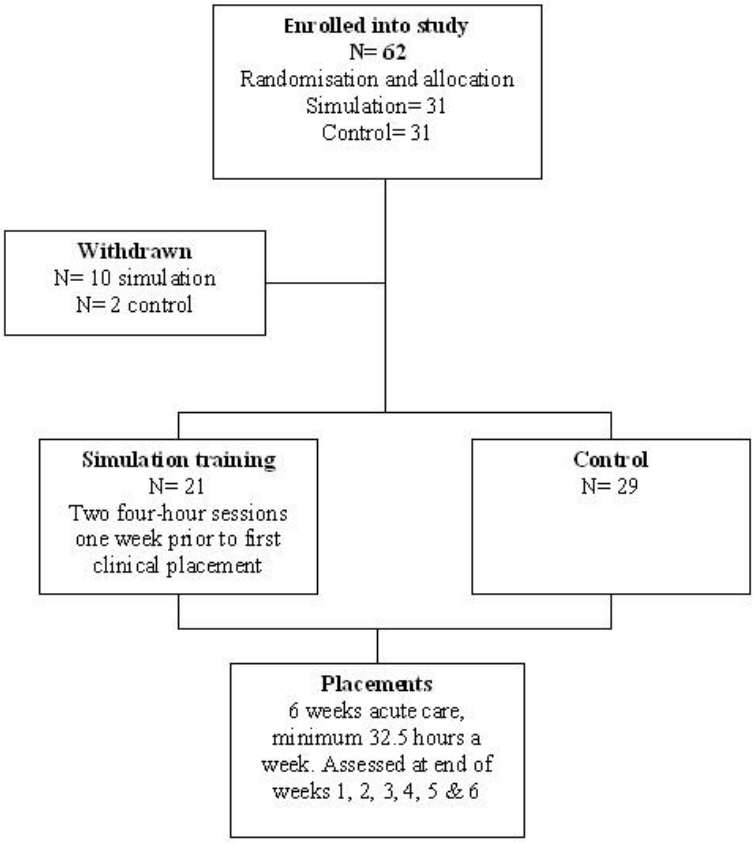
Clinical educators

Clinical educators, who indicated they would participate as assessors, were given verbal and written information about the study. Written informed consent was gained from six clinical educators at four hospital sites where cardiorespiratory placements occurred for JCU students. Clinical educators who participated in the study were blinded to group allocation, although they could not be blinded to participants in the study versus those not on the study due to the additional collection of data for those participating over those not participating. All clinical educators, whether assessing participants or not, were provided with the assessment tool (APP) and training regarding the use of the tool.

Data management

All data were stored in a spreadsheet for ease of data entry and then imported into SPSS version 17 (SPSS, Chicago). Participants were identified using codes to maintain anonymity. All APP forms relating to the study were sent by the clinical educator to the Clinical Education Coordinator, JCU Physiotherapy. Relevant data for participants enrolled in the study were given by the Clinical Education Coordinator to the principal investigator. Original APPs required for participants' university grades were kept by the Clinical Education Coordinator. All written informed consent forms and APP forms were stored in a locked draw of a filing cabinet in the principal investigators office.

Figure 1: Flow diagram of research method.



RESULTS

Sixty two participants were enrolled in the study, with thirty one each in the intervention and control groups. As can be seen in Figure 1, ten participants allocated to the intervention group and two in the control group withdrew from the study prior to attending training or placement. Results are reported only for those students who remained in the study. Both groups were well matched demographically with six males in the control group and 5 in the intervention group. The average age for the control group was 20.4 years and the intervention group 19.9 years. There was no significant difference between the groups pre-clinical placement grades, with the control group mean 64.11, standard deviation 7.16; and simulation group mean 64.93, standard deviation 7.43 ($p=0.64$). Data was not available for all six weeks for all participants. The control group had twenty participants with all data whilst the intervention group had ten. Seven participants in the control group and five participants in the intervention group had only data for week six. Individual student data is presented in Appendix 1.

Results from the APP were collated and data analysis performed. The Mann-Whitney U test was used to compare the intervention and control group because APP scores and pre-clinical placement grades were not normally distributed. Multivariate analysis was undertaken following return of all data to determine if there was any relationship between APP scores and when participants went on placement (i.e. a participant's first through to their fifth placement) or the location where a participant went on placement. There was no significant effect for when or where a participant went on placement.

The first aim of the study, whether physiotherapy students who have additional training on a mannequin simulator would score at least 8% higher on clinical placement as compared to those students who undertake a traditional learning program, was analysed by between group (intervention and control) analysis of competence scores for weeks 1 to 6. No significant differences were found between groups. The second aim, whether the use of a mannequin simulator would reduce by one week, the time needed for physiotherapy students to become competent in cardiorespiratory physiotherapy skills on a clinical placement, was analysed by within group analysis of competence scores to determine whether there was a plateau in APP scores. Table 2

shows there was no plateau in either the intervention or control groups as the APP scores continued to rise. The third aim of the study, whether students with pass scores (50–64.99) in pre-clinical cardiorespiratory units would improve more with training on the mannequin simulator than those without this training, was assessed by between group (intervention and control) analysis for those participants with a pass grade as their pre-clinical placement grade with weeks 1 to 6 competence scores. No significant difference was found in the APP scores between the intervention and control groups in weeks one through to six for pass-only participants.

There was a trend for the intervention group to have a smaller range in their APP scores each week as compared to the control group. Table 2 shows that the smallest difference in the range between the control and intervention group was one grade point for the pre-clinical placement grade. For the APP score, the smallest range difference was two points in week one. The largest difference between the ranges for APP score was week five with a difference of nineteen points.

In this study, the reliability of the APP scores was 0.95 with a 95% confidence interval of 0.92 to 0.97 using the ICC. A power calculation using the actual means and standard deviations found a power of 0.205 with an α of 0.05.

Table 2: Descriptive statistics for each group by week

	Control			Intervention			Mann-Whitney U
	Mean	***Std Dev***	***Range***	***Mean***	***Std Dev***	***Range***	
Preclinical	64.1	7.2	31	64.9	7.4	30	0.62
Week 1	25.9	10.0	34	23.3	10.8	32	0.44
Week 2	33.2	9.3	34	33.6	8.4	24	0.18
Week 3	40.2	8.2	28	40.9	6.6	19	0.51
Week 4	44.4	9.4	35	46.1	8.4	28	0.50
Week 5	51.4	9.8	42	52.5	8.1	23	0.59
Week 6	60.7	9.1	36	58.7	8.4	29	0.35

Discussion

No difference was found between traditional training (control group) and traditional training with additional simulator training (intervention group) as measured by the APP. This was also the same for those participants who had received a pass grade in their pre-clinical placement subjects. Also, there was no difference in the time taken to become competent between the intervention and control group. These findings differ from those of Good (2003) who found that simulation training can reduce the time needed to become competent in the clinical setting.[2]

There are a number of reasons why no difference between groups could be found for the research hypotheses in this study. First, training exposure may not have been long enough. It may be that simulation for more than eight hours is required to show an effect as this study was not looking at teaching psychomotor tasks but integration of assessment and clinical reasoning to develop an appropriate treatment. However, many simulation studies have used less than eight hours of training and have found positive results when investigating learning of psychomotor tasks or communication skills.[1] Eight hours was chosen for this study, as it was more time found in most studies and was achievable given the timeframes of the curriculum.

The second reason may have been that the outcome of clinical practice was only assessed on a weekly basis. Given that simulation training was for eight hours and assessment was completed after a minimum of 32.5 hours, it may be unreasonable to assume that a difference could be detected after the longer time period. Asking physiotherapy clinical educators to assess participants more frequently was felt to add too much workload to the educators and thus potentially reduce recruitment to the study. A third reason may be that simulation needs to be imbedded in the curriculum and not be additional to the curriculum. Embedding the simulation into the curriculum may have resulted in fewer withdrawals in the study and increasing its power. However, many simulation studies have used simulation as a stand alone educational method not embedded into a health science curriculum.[27]

The difference in the ranges between the control and intervention group initially show that the two groups were evenly matched

with regards their knowledge, as assessed by the pre-clinical placement grade and their clinical performance, the week one APP score. As the placements progressed, the difference in the ranges of APP scores changed. The smaller range in scores for the intervention group are in part due to the lowest mark in that group being higher each week than in the control group. As well, the highest APP score each week is also found in the control group. That the lowest mark each week for the APP is not in the intervention group may indicate that the simulation training has helped to improve clinical ability a little more than traditional training alone. If this was the case, it could be assumed that the highest score would also be found in the intervention group, which it was not. It may be that the simulation training helped participants to assess, reason, and treat in a more standardised manner than with the traditional training alone. This may then indicate that students who are at risk of failing clinical placements should receive simulation training prior to attending clinical placements as a remedial measure, even though participants with a pre-clinical placement pass grade did not improve more with simulation training. This study was not powerful enough to accurately determine if simulation for students with a low pre-clinical grade could benefit more from simulation training therefore a larger study is required to investigate this further.

Another reason that this study did not find an improvement in clinical ability may be the fidelity of the simulated experience. This study utilised Nursing Anne, in a ward environment, as the simulator, which allows auscultation findings to be adjusted, as well as blood pressure and heart rate. Medical records, medical attachments and results of clinical investigations, such as chest X-rays, were provided for the participants. Given that the simulator is not able to move independently, it restricts the clinical information that is available for physiotherapy participants. The fidelity, or realism, of a simulated experience is one of the stated reasons for the success of simulation as an education intervention.[27] Nursing Anne is a full body simulator and costs around A$16,000, which is much cheaper than high fidelity simulators. But high fidelity simulators also do not have independent movement except in chest rise and fall and, as such, adds only slightly more realism for physiotherapy assessment and treatment. Further studies are required to determine if high fidelity simulation is more appropriate for physiotherapy. If physiotherapy as a profession wants to utilise simulation as an educational intervention, it may be that it needs to investigate what simulation can be used for or help companies, who develop simulators, to produce a simulator that is more appropriate to physiotherapy needs.

This study has shown that simulation can be used in cardiorespiratory physiotherapy education. Use of simulation as has occurred in this study potentially ensures that students are adequately prepared to assess and treat patients as would be found in acute care. The use of simulation in a non- threatening environment and in a low stakes situation may have allowed students to feel more comfortable and further reinforce a standardised approach to acute care physiotherapy practice.

Limitations

There were a number of issues with the way this study was undertaken which may have a bearing on the results found. There was a delay between participants receiving simulation training and when they may have attended their acute care clinical placement. Due to financial and logistical reasons, all participants were trained prior to attending their first clinical placement. This meant that there could be up to nine months delay between simulation training and cardiorespiratory/acute care clinical placement and thus assessment with the APP. With a delay, a participant could have forgotten some of the lessons learned during the training experience. However, statistical analysis showed that there was no effect for when the participant went on placement and thus this delay appeared to have had minimal effect.

Cardiorespiratory/acute care clinical placements were provided in a number of public hospital sites which meant that multiple clinical educators were involved in assessing participants. Multivariate analysis determined that there was no significant effect on the APP scores across the multiple sites. Even though Dalton et al have shown that the APP has good inter-rater reliability (0.96 ICC), which was reproduced in this study (0.95 ICC), it is not possible to rule out any effects the different sites and different physiotherapy clinical educators had on the results due to the small sample size making it more difficult to pick up these differences.[26] It may be that different clinical sites and educators had more affect on some participants' learning than other sites and educators. Learning style preferences was not assessed in this study and potentially should be included in further investigations. It is recommended that the APP continue to be used as an outcome measure for clinical ability in physiotherapy simulation trials as it has found to be a valid and reliable measure.

There was a large amount of missing data in the study. It appeared that asking clinical educators to remember to assess some students on a weekly basis caused problems. This may have been due to the increased workload required to assess on a weekly basis or it may simply have been that the educators forgot who they had to assess weekly. Emails and phone calls were sent to remind clinical educators to assess participants in the study, as not all students who attended acute care placements were enrolled into the study. One possible solution to for this could be that in future studies, all students, regardless of participation, should be assessed in the same timeframes.

Whilst the study was able to enroll thirty-one participants each into the intervention and control group, there were withdrawals, especially from the intervention group where there were ten withdrawals and two withdrawals in the control group. This was mainly due to participants being unable to attend simulation training in the week it was run. The only way to ensure a minimum of thirty participants within each group, even after withdrawals, would have been to continue the study for a third year. However, it was not possible to continue into a third year because changes were required to the physiotherapy curriculum and clinical placement lengths were changed from six weeks to five weeks due to an agreement between all physiotherapy programs within Queensland and at the request of Queensland Health physiotherapy staff. These changes to the curriculum and clinical placements meant that other cohorts could not be directly compared to the data already collected.

Finally, there has been discussion in the literature regarding research design and educational interventions with some authors favouring randomised controlled trials and others highlighting the limitations of randomised controlled trials.[28, 29] Potential limitations of randomised controlled trials in education are the ability to control all variables; for example, participant and teacher motivation affects all learning interventions and is difficult to control. The amount of impact that these had on the study is impossible to calculate.

CONCLUSION

The use of an additional two four hour sessions of simulation training in cardiorespiratory/acute care physiotherapy, as undertaken in this study, led to no significant improvement in clinical ability as measured by the APP. Further investigation is needed to determine whether simulation has the potential to replace cardiorespiratory/acute care physiotherapy clinical experiences. This research needs to take into account the fidelity of the simulated experience, whether simulation should be for a longer period of time, be integrated into the curriculum, or used specifically for students with a pre-clinical subjects pass grade.

This study used clinical ability as an outcome measure for an educational intervention in a health science professional program. It reproduced the very high inter-rater reliability for the APP found in a previous study and thus is a suitable measure for assessing clinical ability. Although the literature contains reports of benefits from the use of simulation, very few studies use clinical ability as an outcome measure. However, this study highlights the need for more research into the clinical benefits of simulation education interventions prior to large amounts of time and money being spent on wider scale implementation. This study also highlights that although simulated experiences may be beneficial, the actual approach and method of simulated experience impacts on the outcome. It can not be assumed that just because simulation is used as an education method, a positive learning outcome will occur.

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Appendix 1: Individual student data

ID	Group	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Preclinical score
1	Control	30	38	40	40	46	56	63.50
2	Control	29	33	36	47	57	65	58.93
3	Control	22	24	35	39	41	57	63.75
4	Control	13	28	34	36	43	48	63.38
5	Control	28	35	38	40	55	62	52.25
6	Control	12	26	35	36	48	59	81.88
7	Control	44	46	59	66	73	78	57.38
8	Control	20	25	34	40	48	54	66.50
9	Control	33	40	47	55	70	75	83.13
10	Control	41	47	53	58	61	75	55.25
11	Control	20	25	38	40	44	61	63.50
12	Control	14	21	31	31	43	48	67.88
13	Control	21	25	37		31	54	58.13
14	Control	32	36	43	44	55	62	69.50
15	Control	27	30	38	42	54	59	60.91
16	Control	10	26	34	35	52	65	61.63
17	Control	23	27	36	39	43	42	62.75
18	Control	42	45	47	51	52	57	59.93
19	Control	19	25	31	35	44	49	63.75
20	Control	25	32	36	47	58	67	72.13
21	Control	39	42	43	50	52	62	64.75
22	Control		55	59	61	61	61	70.38
23	Control						64	65.50
24	Control						67	57.88
25	Control						49	52.75
26	Control						76	67.00
27	Control						57	63.00
28	Control						59	60.88
29	Control						73	71.13
30	Intervention	31	33	38	47	47	55	69.13
31	Intervention	13	26	37	37	44	55	60.88
33	Intervention	14	27	32	32	41	45	60.50
34	Intervention	11	25	34	37	54	61	60.88
35	Intervention	26	36	43	48	64	67	64.50
36	Intervention	43		48	50	56	56	72.25
37	Intervention	17	30	36	39	44	49	73.75
38	Intervention	29	29	33	48	48	48	67.75
39	Intervention	19	27	37	43	45	56	65.00
40	Intervention	15	25	36	38	42	56	61.75
41	Intervention	38	45	51	60	60	66	66.13
42	Intervention		49	50	58	62	70	55.63
43	Intervention		44	44	50	58	65	59.63
44	Intervention		40	51	57	64	72	80.88
45	Intervention			46	47	59	65	53.63
46	Intervention			39		52	52	67.75
47	Intervention						56	63.38
48	Intervention						46	70.88
49	Intervention						74	50.75
50	Intervention						62	76.38
51	Intervention						56	62.13