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Effectiveness of Simulation-Based Learning on Clinical Competence in Dietetics Students: A Narrative Review

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Research Brief

Effectiveness of Simulation-Based Learning on Clinical Competence in Dietetics Students: A Narrative Review

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ABSTRACT

Clinical supervised practice experiences offered through dietetic internships have historically been among the most challenging to obtain. The COVID-19 pandemic heightened the scarcity of these experiences and forced dietetics education programs to offer alternative experiences in the absence of direct patient care opportunities. Simulation-based learning experiences (SBLE) or objective structured clinical examinations (OSCE) are one method of providing these alternative options, and if effective, could be routinely incorporated into dietetics education. This review evaluates five original research articles to determine the effectiveness of simulation-based learning on perceived or observed clinical competence in dietetic students. The findings of the studies unanimously suggest that SBLE is effective for improving clinical competence in this population. Further research with larger, more diverse sample sizes and expanded study designs that include randomized controlled groups are needed to confirm these results.

KEYWORDS

simulation-based learning experiences, objective structured clinical examinations, dietetics education, clinical skills, clinical competence

INTRODUCTION

Healthcare and healthcare education in the United States (US), along with the rest of the world, continues to be shaped by the aftermath of the COVID-19 (severe acute respiratory syndrome coronavirus 2) pandemic.[1,2,3] The number of COVID-19 hospitalizations placed a considerable strain on the US healthcare system and those who provide the care.[2-4] The growing demands on healthcare professionals including increased patient loads and reduced workforce numbers along with constraints caused by the pandemic such as social distancing and quarantine requirements have led to a reduction in time and resources available for preceptors to train healthcare

students.[2,5] This has forced many health-related professions to transform their student training programs by increasing simulation-based learning experiences (SBLE)[6] or objective structured clinical examinations (OSCE)[7] in the absence of direct patient care opportunities.[8] Dietetics education is no exception.[5,9] Dietetics programs offering supervised practice opportunities have had to creatively reimagine their curriculum to include a variety of simulated learning modalities.[9]

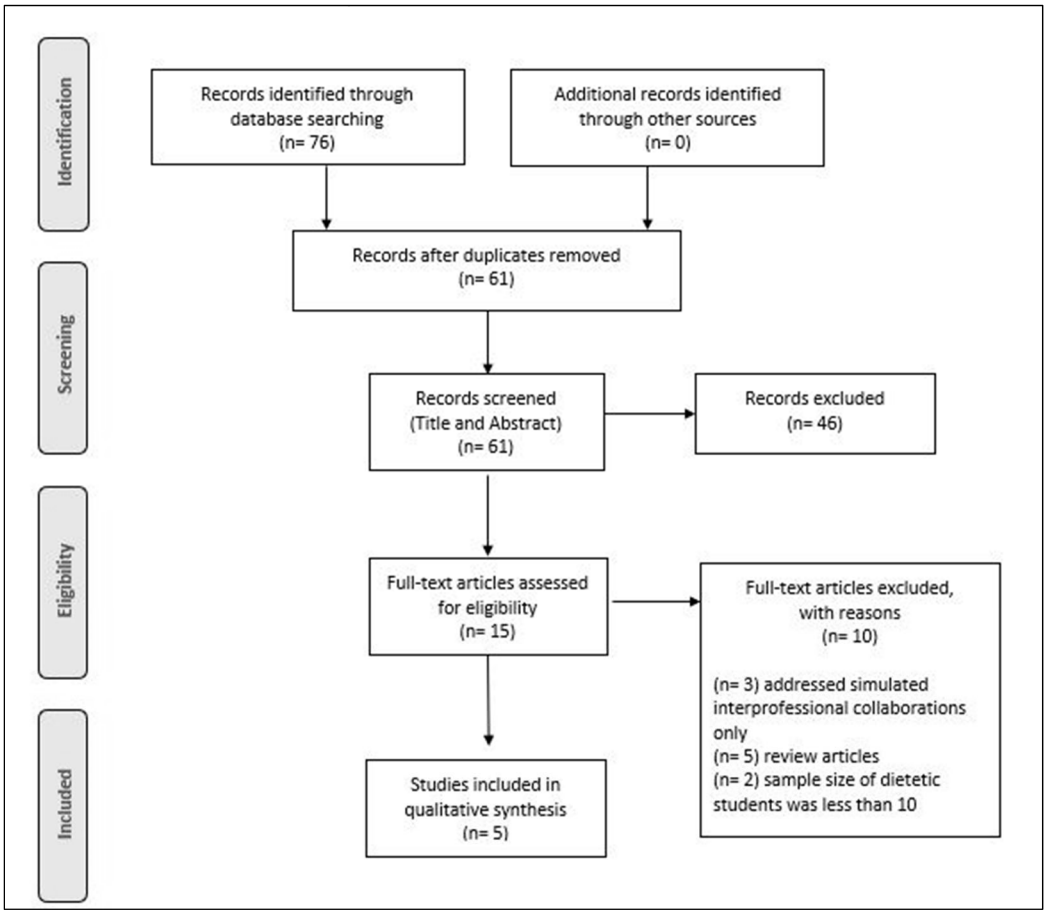

Figure 1. Simulation-Based Learning and Clinical Competence Search Strategy using Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Flow Diagram[14]

Alternative learning experiences through simulations, however, are not a new concept in education. Simulated learning activities have been present in student healthcare education programs for many years offering a wide variety of experiences ranging from hands-on instruction, with the use of mannequin simulators and standardized patients (SP) also referred to as simulated participants, role-playing, and computer-based simulation options.[10,11] SP simulation uses scripted scenarios where actors portray patients in clinical settings.[10] "Fidelity" refers to the level at which simulations are consistent with real-life experiences.[10] High-fidelity patient simulations (HFPS) can be representative of a single or combination of modalities that are designed to immerse trainees in realistic situations.[10]

Accreditation standards for health-care professional programs include language that allows the use of SBLE for the fulfillment of clinical competency requirements. One example of this is the Commission on Collegiate Nursing Education (CCNE), the accrediting agency of nursing programs.[12] The "teaching-learning practices" section of the standards authorizes simulations to be utilized as an instructional offering.[12] Another example is the Accreditation Council for Education in Nutrition and Dietetics (ACEND).[13] The 2022 iteration of the Standards for Nutrition and Dietetics Internship Programs allows 300 of the required 1000 supervised practice hours to be completed through "alternative experiences" such as simulations.[13] With ACEND allowing nearly a third of the supervised practice hours required for obtaining entry-level competence as a registered dietitian nutritionist (RDN) to be attained through simulations,[13] the aim of this

review is to evaluate the effectiveness and self-efficacy of SBLE on perceived or observed clinical competence among students enrolled in dietetics programs.

METHODOLOGY

Literature searches were completed in the Cumulative Index to Nursing and Allied Health and PubMed databases. The search terms included dietetics education, dietetics students, dietetics, simulation, simulated, simulate, patient simulation, simulation training, nutrition focused physical exam, NFPE, nutrition exam, and nutrition assessment. Articles were included if publication date was between 2017 and 2023. They were excluded if subjects were enrolled in non-dietetics healthcare programs or were practicing RDNs, simulated experiences were interprofessional collaborations only, study groups contained fewer than 10 participants, and outcomes measured were not related to clinical competence. Reference lists from primary research articles and systematic reviews were searched for relevant studies not captured with initial database searches. A total of 76 articles were found through database searching and 61 were reviewed after duplicates were removed. Fifteen full-text articles were evaluated for eligibility and five were retained and included as part of the qualitative synthesis (Figure 1).

RESULTS

A study by Buchholz et al[15] assessed the effect of SP simulation use on nutrition-care competence and communication of undergraduate and graduate dietetic students.[15] This pre-post observational study, conducted in Canada, evaluated the change scores of observed nutrition-care skills and communication performance indicators (PI) for 17 undergraduate (final n= 15) and 15 graduate students when conducting SP simulations.[15] The undergraduate students were initially evaluated at week four of a 12-week curriculum and again at week 12 using SPs with the same condition while the graduate students were evaluated at week three, week five, and week six, of a six-week curriculum, using SPs with different conditions.[15] All students received SP simulation training between initial and final evaluations.[15] Statistically significant differences in nutrition-care PIs were identified between initial evaluation and final evaluation mean scores for both undergraduate ($p < 0.001$) and graduate students ($p < 0.001$) (Appendix 1) suggesting that SP simulation training is effective for improving observed nutrition-care competence skills in dietetic students.[15]

Similarly, Tyler et al[16] conducted a pre-post observational study of US dietetic students to evaluate the effect of simulation training on observed and perceived nutrition-focused physical exam (NFPE) skills.[16] In this study dietetic interns from three separate cohorts were observed for NFPE skills competence and were asked to self-evaluate their skill level at two distinct times throughout the study.[16] The first cohort of interns received an interactive simulation lecture and NFPE resources ahead of the first observation and self-efficacy survey.[16] The investigators determined that the study design should be slightly modified for the second and third cohorts to conduct the initial evaluation of NFPE skills and pre-survey ahead of any simulation training.[16] All subjects were observed conducting skills of NFPE on SP after receiving NPFE simulation training and were asked to rate their self-efficacy with NFPE skills upon completion of the training. No statistically significant improvements were found in mean observed NFPE skills with cohort 1 (n= 16; p= 0.32) however, with the curricular modifications made for cohorts 2 (n= 15) and 3 (n= 16), statistically significant improvements ($p < 0.001$) were observed.[16] Additionally, despite the timing of the pre-survey, all cohorts showed statistically significant perceived improvements in NFPE skills ($p < 0.001$).[16] Both Buchholz et al[15] and Tyler et al[16] suggest that nutrition care and NFPE skills can be improved using SP simulations.[15,16]

Like the study by Tyler et al[16] three other studies by Tada et al,[17] Alkhaldy et al,[18] and Todd et al[19] also evaluated self-efficacy related

to clinical skills competence.[16-19] The Tada et al[17] study took a similar design approach to Tyler et al.[16] In this study three cohorts of 3rd year, undergraduate dietetic students in Japan, ages 20-38 years, were asked to rate their self-efficacy with Nutrition Care Process (NCP) skills in a pre and post-simulation survey.[17] This repeated-measures pre-post observational study was considerably larger than Tyler et al[16] with 90 participants total in cohorts of 23, 39, and 28 each.[17] After completing a pre-self-efficacy survey, each cohort of participants underwent simulation training with SPs and were then asked to take a post-simulation survey.[17] The researchers found that mean difference in scores from pre to post-survey were statistically significant (p= 0.01) indicating, as with the Tyler et al[16] study, that SP simulation training is effective for improving self-efficacy with clinical skills in dietetic students.[17]

Another repeated measures pre-post observational study that assessed the effectiveness of simulation training on self-efficacy with clinical skills was conducted by Alkhaldy et al.[18] In this study, 41 undergraduate, female clinical nutrition students in Saudi Arabia, ages 20-23 years, were surveyed to determine their perceptions of simulation learning and confidence level with NCP and Nutrition Care Process Terminology (NCPT) skills before and after HFPS training.[18] As with the Tyler et al[16] and Tada et al[17] studies, self-efficacy surveys were administered to participants before receiving simulation training and then again after the training was provided.[18] What differed from the previous studies, however, was that rather than using SPs alone for simulation, HFPSs were utilized instead.[18] The study results were similar to the findings of the previous studies[16,17] in that the authors reported statistically significant increases in self-efficacy with NCP and NCPT skills when comparing pre and post-simulation mean survey values (p= 0.01) suggesting once again that simulation training, regardless of modality, is effective for improving self-efficacy with clinical skills.[18]

Lastly, Todd et al,[19] like Alkhaldy et al,[18] evaluated the effectiveness of HFPS on increasing the self-efficacy of dietetic students before entering clinical supervised practice.[19] Similar to the previous studies[16-18] Todd et al[19] used a repeated measures pre-post survey design.[19] The subjects (n= 19) were 95% female, 75% Caucasian, enrolled in a master's coordinated program in the US, and ranged in ages from 22-49 years.[19] In this study, the investigators used a self-efficacy scale (SES) given to subjects at three points during the study, before simulation training, after simulation training, and two weeks into supervised practice clinical rotations.[19] The subjects' median confidence level scores significantly increased between pre and post-simulation training (p= 0.03) and post-simulation training versus two weeks into clinical supervised practice rotations (p= 0.002).[19] The results of this study confirmed what the previous studies found regarding the effectiveness of simulation training on improved self-efficacy with clinical skills related to pre/post study design but also expanded the findings into practice (Appendix 1).[19]

DISCUSSION

The results of all five studies[15-19] suggested that simulation training, using a variety of modalities, improved observed or perceived clinical competence. The pre-post observational study design with the use of convenience samples across all studies lent itself to high retention rates despite small sample sizes.[15-19] What all the studies lacked, however, was randomization with a control group to compare and validate the intervention group outcomes.[15-19] While minimal demographic data were provided by three of the studies,[17-19] overall, the generalizability of the findings was limited across all studies due to most subjects being female with little race and ethnic diversity.[15-19] However, the studies represented international dietetics education with one taking place in Canada,[15] another in

Japan,[17] one in Saudi Arabia,[18] and two in the US.[16,19]

Limitations

While the studies reviewed shared several commonalities, there were noted differences among them. For example, two of the studies provided data on observed improvements with clinical skills,[15,16] while three did not measure this outcome.[17-19] Four of the studies measured self-efficacy with clinical skills[16-19] and one did not.[15] All but one study[15] relied on some level of self-rated outcomes that may have led to reporting bias.[16-19] The Buchholz et al,[15] Tyler et al,[16] and Tada et al[17] studies utilized SP simulations only, whereas Alkhaldy et al[18] and Todd et al[19] used HFPS instead. While all studies[15-19] assessed dietetic students, the program types and years of study varied among them. Two studies[17,18] evaluated undergraduate students alone, one study[15] evaluated undergraduate and graduate students, another study[19] evaluated only graduate students, and the last study[16] only assessed dietetic interns. The only study of the five to consider and adjust the statistical analysis for confounding variables was Todd et al[19] that addressed the possible bias of prior clinical experience among the subjects.[19]

Implications for Dietetic Education

The five primary research studies evaluated in this review[15-19] support SBLE as effective for improving clinical competence among dietetic students. Perceived improvements in clinical skills were evident in four of the studies[16-19] while observed improvements in clinical skills were seen in two.[15-16] Despite simulation modes varying slightly among studies, three[15-17] utilizing SP simulations and two[18-19] providing HFPS, the studies uniformly found that simulation training was beneficial in improving clinical skills.

These findings are encouraging not only for dietetics programs but also for the nutrition and dietetics profession in general. For programs preparing students for supervised practice, the results of these studies[15-19] suggest that simulation training can add an element that enhances student readiness for supervised practice. Adding SBLE to the curriculum may enrich the quality of the program while increasing the competence of the student. As ACEND transitions to competency-based education with the future education model standards,[20] student readiness with clinical skills will become vital for successfully demonstrating clinical competence in supervised practice settings. Likewise, programs that offer a supervised practice component can supplement their direct patient contact hours with simulations that serve as efficacious alternative experiences when direct patient contact hours are limited or specific population groups or conditions are not available. This may alleviate the pressure many program directors and students face when attempting to solidify highly coveted supervised practice clinical rotations, particularly with the ongoing (pervasive) uncertainties associated with adapting to an endemic COVID-19 situation and other barriers to clinical education.[21] SBLE could serve as a supplement to clinical hours when secured rotations are disrupted. For clinicians working in the field, SBLE may assist in developing and enhancing clinical skills outside of direct patient care. Depending on the simulation, activities could be scheduled at the clinician's convenience as to not interfere with patient care. Overall, simulation training can offer a flexible, low risk learning environment demonstrated to augment clinical competence.

Future Research

While the five articles[15-19] evaluated in this review offer promising results surrounding SBLE, additional research on the topic is needed. The sample sizes for the studies were considerably small with the largest[17] containing fewer than 100 subjects. Future studies with larger sample sizes should be administered to substantiate current findings.

The available research utilized convenience samples that were not randomized and did not include a control group. Future research

should include study designs that randomize subjects and include control groups that do not receive training to corroborate findings. Additionally, future studies that do not rely on self-reporting may reduce the potential for outcome bias that may have been present in the studies reviewed.[15-19]

Furthermore, future studies should evaluate and compare simulation modality outcomes between modes. These studies did not evaluate differences in clinical skill improvements between one type of simulation and another. Low fidelity simulations may have similar benefits to high fidelity options. Targeting the most effective simulations tools for dietetics instruction may help educators better determine where simulation resources should be allocated.

Though the studies included in this review[15-19] were conducted in several countries, it is difficult to evaluate their generalizability as little to no demographic information was provided. In the instances where demographics were reported[17-19] the information was limited to gender and age with only one specifically mentioning race.[19] Since the current body of work represents mostly female subjects, future studies should be more representative and inclusive of all genders.

Future research should identify confounding variables that may be present as students are learning from simulation activities and adjust statistical analysis accordingly. Only one study[18] of the five[15-19] addressed and adjusted statistical analysis for this. Many factors may influence improvements in clinical skills such as baseline clinical competence levels and independent practice outside of the study. Those differences should be addressed and accounted for to create the most effective learning environments with the most appropriate simulations.

Lastly, future studies should explore translational research demonstrating the effectiveness of simulation training in nutrition and dietetics practice with interprofessional components where healthcare disciplines collaborate to deliver comprehensive approaches to patient care.

CONFLICTS OF INTEREST

The authors report no conflicts of interest.

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Table 1. Studies Evaluating the Effectiveness of Simulation-Based Learning Experiences on Perceived or Observed Clinical Competence in Dietetic Students

Study	Study Purpose	Study Population and Setting	Intervention and Setting	Outcome Data	Conclusions	Strengths/ Limitations of Findings
Buchholz et al[15] • 2020 • Pre-post observational study • Canada • No funding source disclosed	To evaluate the effectiveness of SP simulation use on nutrition-care competence and communication of dietetic students.	Undergraduate and graduate dietetic students enrolled in nutrition courses at the University of Guelph 32 participants total • Undergraduate (n= 17 initial; 15 final) • Graduate (n= 15) • No participant demographics or characteristics provided • Retention 93.75% • Attrition 6.25%	Use of SP simulations between 1st and 2nd observation of nutrition-care competence skills to evaluate improvements SP simulations conducted on a university campus.	Mean improvement scores for nutrition-care PI in undergraduate students between 1st and 2nd evaluation: • Mean 1st evaluation: 1.8 • Mean 2nd evaluation: 2.7 • Max score: 3.0 • (p <0.001) Mean improvement scores for nutrition-care PI in graduate students between 1st and 2nd evaluation: • Mean 1st evaluation: 1.9 • Mean 2nd evaluation: 2.6 • Max score: 3.0 • (p <0.001)	SP simulation training is effective for improving observed nutrition-care competence skills in dietetic students.	Strengths: • Retention rate Limitations: • Small sample size • No control group • SP simulations identical for undergraduate students but varied for graduate students • Study samples not randomized • No demographic data reported • No control over nutrition-care competence and communication practice outside of study
Tyler et al[16] • 2020 • Pre-post observational cohort study • United States • No funding source disclosed	To develop and utilize simulation training for the improvement of NFPE skills in dietetic students.	3 student cohorts enrolled in a dietetic internship program at the University of Kansas Medical Center 47 participants total • Cohort 1 (n= 16) • Cohort 2 (n= 15) • Cohort 3 (n= 16) • No participant demographics or characteristics provided • Retention 100% • Attrition 0%	Use of NFPE simulation training between pre and post surveys and observations to evaluate NFPE skill improvements. Interactive simulation training lecture and SP simulation conducted on a university campus.	Observed improvements in overall NFPE skills **Cohort 1** • Mean baseline score: 15.3 • Mean final score: 16.6 • Max score: 27.0 • (p= 0.32) **Cohort 2** • Mean baseline score: 16.9 • Mean final score: 22.3 • Max score: 27.0 • (p <0.001) **Cohort 3** • Mean baseline score: 7.0 • Mean final score: 20.0 • Max score: 27.0	NFPE simulation training is effective for improving observed and perceived NFPE skills in dietetic students.	Strengths: • Retention rate • Standardized simulation techniques/tools used to evaluate NFPE skill improvements/changes Limitations: • Small sample size • No control group • Study samples not randomized • No demographic data reported • Pre and post NFPE skills assess performed under different conditions

Study	Study Purpose	Study Population and Setting	Intervention and Setting	Outcome Data	Conclusions	Strengths/ Limitations of Findings
				• (p <0.001) Perceived improvements in overall NFPE skills across all cohorts in the categories of: touching pts, and assess fat stores, muscle stores, fluid accumulation, functional status, and micronutrient def: • Median pretest: 3 • Median posttest: 4 • Max score: 5 • (p <0.001)		• Inconsistent study conditions between cohorts • Self-rated outcomes subject to bias
Alkhaldy et al[17] • 2019 • Repeated-measures pre-post intervention study • Saudi Arabia • No funding source disclosed	To evaluate dietetic students' perceptions of simulation learning and confidence after use as well as assess the impact of HFPS on students' self-efficacy with NCT/NCPT skills.	Senior year undergraduate female students ages 20-23 yrs enrolled in the clinical nutrition program at King Abdulaziz University 41 participants total • Retention 100% • Attrition 0%	Participation in HFPS learning session between pre and post self-efficacy skills survey. HFPS conducted within a university campus simulation laboratory.	Self-efficacy score in pre vs post simulation: • Mean pre: 3.0 • Mean post: 3.2 • Max score: 4.0 • (p= 0.01)	HFPS training is effective for improving self-efficacy with NCP/NCPT skills in dietetic students.	Strengths: • Retention rate • Simple yet effective study design Limitations: • Small sample size • No control group • Study samples not randomized • Participants were all females in Saudi Arabia ages 20-23 • Self-rated outcomes subject to bias
Tada et al[18] • 2018 • Repeated-measures pre-post intervention cohort study • Japan • No funding source disclosed	To evaluate the effectiveness of SP simulation learning on self-efficacy with NCP skills in dietetic students.	3 cohorts of 3rd year undergraduate dietetic students ages 20-38 yrs enrolled in the dietetic program at Chugoku Gakuen University 108 participants recruited, 18 declined to participate 90 participants total • Cohort 1 (n= 23): female only	Use of SP simulations between pre and post self-efficacy skills survey. SP conducted within a university campus simulation laboratory.	Self-efficacy scores in pre vs post simulation: • Mean pre: 61.9 • Mean post: 64.8 • Max score: 125.0 • (p= 0.01)	SP simulation training is effective for improving self-efficacy with NCP skills in dietetic students.	Strengths: • Retention rate • Simple yet effective study design Limitations: • No control group • Study samples not randomized • Participants predominately females and all Japanese

Study	Study Purpose	Study Population and Setting	Intervention and Setting	Outcome Data	Conclusions	Strengths/ Limitations of Findings
		• Cohort 2 (n= 39): 3 males, 36 females • Cohort 3 (n= 28): 1 male, 27 females • Retention 100% • Attrition 0%				• Self-rated outcomes subject to bias
Todd et al[19] • 2016 • Repeated-measures pre-post intervention study • United States • No funding source disclosed	To evaluate the effectiveness of HFPS on increasing the self-efficacy of dietetic students before entering clinical supervised practice.	Students enrolled in a dietetic masters coordinated program at Georgia State University 19 participants total • 95% female • 79% Caucasian • Age range 22-49 yrs • Retention 100% • Attrition 0%	Participation in HFPS between pre and post completion of SES. SES was completed a 3rd time 2 weeks after starting clinical supervised practice rotation. HFPS conducted within a university campus simulation laboratory.	Confidence level scores pre vs post simulation training and post vs 2 weeks into clinical supervised practice rotation. Pre vs post: • Median pre: 1.5 (IQR 1.2-1.8) • Median post: 1.5 (IQR 1.3-2.0) • Max score: 4.0 • (p= 0.03) Post vs 2 weeks into clinical supervised practice rotation: • Median post: 1.5 (IQR 1.3-2.0) • Median 2 weeks into clinical supervised practice rotation: 2.2 (IQR 2.0-2.4) • Max score: 4.0 • (p= 0.002)	HFPS training is effective for improving self-efficacy of clinical skills in dietetic students ahead of entering clinical supervised practice rotations.	Strengths: • Retention rate • Statistical analyses adjusted for confounding variable of previous pt care experience Limitations: • Small sample size • No control group • Study samples not randomized • Participants predominantly Caucasian females • Clinical supervised practice rotation placement varied between 4 to 18 weeks from subject to subject which may have led to recall bias

Abbreviations: **Assess**, assessment; **Def**, deficiency; **HFPS**, high-fidelity patient simulation; **IQR**, interquartile range; **Max**, Maximum; **NCP**, Nutrition Care Process; **NCPT**, Nutrition Care Process Terminology; **NFPE**, Nutrition Focused Physical Exam; **PI**, performance indicator; **Pt**, patient; **Pts**, patients; **SES**, self-efficacy scale; **SP**, standardized patient; **Stat sig**, statistical significance; **Vs**, versus; **Yrs**, years.