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ORIGINAL RESEARCH

Weight bias education to address weight-related attitudes and perceptions in healthcare professionals

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ABSTRACT

Introduction

Weight bias (WB), defined as negative attitudes, beliefs, assumptions and judgements towards individuals with overweight or obesity, can adversely affect patient care. Despite approximately 42% of US adults living with obesity, formal WB training in healthcare professions curricula remains limited. This study examined the impact of the educational format on learners' perceptions of weight and obesity.

Methods

A WB curriculum was implemented in three phases within a campus-wide interprofessional education (IPE) framework at an academic health centre. Phase I consisted of a 2-hour didactic lecture for physician assistant students addressing the limitations of body mass index (BMI), the impact of WB and counselling strategies. Phase II introduced an interprofessional simulated patient encounter emphasising collaborative care planning, counselling and structured debriefing. Phase III expanded the simulation to incorporate food insecurity as a social determinant of health, requiring consideration of contextual factors influencing nutritional decision-making. Pre- and post-intervention surveys assessed WB perceptions, beliefs about obesity causes and outcomes, and interprofessional competencies.

Results

Across three phases (N = 115), WB education shifted learners' perceptions. Compared with Phase I, Phases II and III demonstrated greater improvements in perceived treatment outcomes across external, ability and character domains (p < 0.05–0.001). Phase III showed the largest gains in beliefs about patient

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compliance (+0.83 vs. +0.35) and ability (+0.31 vs. –0.09). Phase II improved ICCAS scores (mean +9.3%). Simulation effectiveness was rated highly (3.9–4.7/5).

Conclusion

Interprofessional simulation addressing WB may improve learner attitudes towards patients with obesity. Integrating social determinants may further enhance outcomes, supporting simulation as a valuable modality for equitable healthcare education.

What this study adds

- Weight bias (WB) education is rare despite the prevalence of this bias among healthcare professionals.
- Most published educational initiatives to address WB do not involve active learning strategies such as simulation.
- Interprofessional WB simulation education is not currently described in the literature.
- The WB simulation experience is effective for interprofessional learners.
- WB simulation may represent one strategy to support culture change both within healthcare institutions and society.
- WB simulation content can be effectively paired with other key learning targets that impact conversations regarding weight and nutrition.

Introduction

Weight bias (WB) is defined as negative weight-related attitudes, beliefs, assumptions and judgements directed towards individuals with overweight or obesity [1]. This bias has permeated the medical community, and evidence suggests that medical professionals with WB spend less time, demonstrate less respect, provide fewer treatment options and recommend inappropriate interventions with overweight and obese patients [2–4]. Such bias may contribute to healthcare avoidance, diminished trust and adverse clinical outcomes. The prevalence of obesity in the United States exceeds 40% [5], as reported by the National Health and Nutrition Examination Survey, underscoring the importance of preparing healthcare professionals to deliver evidence-based, non-stigmatising care. Many medical providers report feeling ill-equipped to counsel patients with obesity [6], with causes including inadequate training time devoted to weight or weight-related issues [7,8]. These educational gaps may perpetuate attribution beliefs that obesity is primarily the result of personal failure, lack of motivation or poor self-discipline. Such attribution patterns reinforce explicit bias and may negatively influence clinical interactions.

Educational initiatives designed to address the complex, multifactorial nature of obesity and WB, should have a goal of increasing providers' confidence and capability to effectively address weight-related topics with patients. There is evidence to support that incorporating a variety of educational methodologies, including active learning strategies, is effective in teaching the management of patients with obesity to medical students, as well as improve student attitudes and decreasing explicit bias [7,8]. Despite this, utilisation of simulation education to teach and address WB is rare, especially for interprofessional learners [9,10]. Interprofessional simulation involves learners from two or more professions learning from, with and about each other in a simulation educational event [11]. Interprofessional simulation provides a structured environment in which learners can engage in collaborative clinical decision-making while practising communication skills and receiving facilitated debriefing [12]. Simulation addressing sensitive topics may support transformative learning by promoting reflection, perspective-taking and critical examination of assumptions [13]. Incorporating contextual factors – such as social determinants of health (SDOH) – may further shift attribution beliefs from individual blame towards systemic understanding.

This study describes the phased development of a WB educational initiative progressing from discipline-specific lecture to interprofessional simulation and subsequently to simulation incorporating food insecurity as a contextual cofactor. We examine the effect of this education on healthcare students' perceptions of patient weight. Our aim is to provide guidance for simulation educators seeking to design and implement WB education within interprofessional training environments.

Methods

Curriculum development

This curriculum was developed at an academic health centre that consists of five colleges (health professions, medicine, nursing, pharmacy and public health) and a graduate school hosting more than 70 academic plan programmes. Each programme has discrete authority over curriculum materials that meet required accreditation competencies and standards for knowledge and performance. Programmes guide curricular content in alignment with emerging standards of practice and evolution of the healthcare environment. In addition to discipline-specific educational requirements, the

university adopted a campus-wide interprofessional education (IPE) curriculum requirement for matriculates of 2015 and forward. This adoption recognises the critical importance of IPE and collaborative practice to improve health outcomes. The IP curriculum framework is grounded in the Interprofessional Education Collaborative (IPEC) domains – Values and Ethics, Roles and Responsibilities, Effective Communication, Teams and Teamwork [14]. IP curriculum activities are grounded in Quadruple Aim context to improve patient experience and outcomes, improve population health, reduce cost of care and improve provider satisfaction and wellness [15]. Content development for instruction and application regarding WB has been implemented in three phases. Phase I originated in focused training for students in the Physician Assistant Studies programme as a traditional lecture format. Upon completion of this discipline-specific training, a team of cross-college faculty adapted delivery of the WB content to incorporate interprofessional and simulation education methodology for Phase II. Finally, content for the simulation activity was expanded to explore alignment of WB learning objectives with a contributing factor of food insecurity related to patient care interventions in Phase III. Specific aims of this phased series for WB were to (1) enhance understanding of WB stigma and resulting health disparities, (2) enhance understanding and application of the IPEC domains and (3) evaluate students' weight-related perceptions and attitudes across the three delivery formats.

Phase I implementation: traditional lecture format

The traditional lecture model group was comprised of first-year students from the physician assistant programme. This group attended an in-person 2-hour didactic lecture on weight management delivered by a registered dietician as part of the Clinical Nutrition course. Lecture topics included an in depth analysis of body mass index (BMI) and its limitations, WB in the medical community and its effects on health outcomes, prevalence and impact of WB across many domains, including the medical community and counselling strategies for patients with obesity.

Phase II implementation: simulated patient encounter

The simulation activity group consisted of interprofessional learners from multiple colleges (Table 1). The learning experience was developed by a workgroup of subject matter experts (SMEs) for IPE and simulation methodology, two registered dieticians, a physician assistant and a pharmacist. The simulation cases were developed collaboratively by faculty with expertise in IPE, simulation methodology, pharmacy, physician assistant education and nutrition. Cases were designed iteratively to align with learning objectives related to WB recognition, patient-centred communication and collaborative care planning. Standardised participants (SPs) subsequently contributed to refinement of case language, emotional realism and authenticity based on lived experiences related to WB and stigma in healthcare interactions. The in-person simulated patient encounter was based on a primary care visit for a new diagnosis of pre-diabetes utilising simulated patients (SPs) with obesity. Six experienced SPs from the institution's established standardised participant programme participated in the simulation activities. SPs were recruited following case development based on alignment with the physical and experiential characteristics required for the scenarios. Participation was voluntary and SPs were informed in advance regarding the educational goals, emotionally sensitive nature of the content and expectations for participation prior to opting into the activity. All SPs had significant prior experience participating in healthcare simulation and communication-focused educational encounters. Prior to implementation, SPs participated in a 2-hour faculty-led training and orientation session reviewing simulation learning objectives, role portrayal, anticipated learner interactions, approaches to maintaining consistency across encounters and strategies for providing learner feedback. Training additionally addressed psychological safety considerations and discussion of the potentially emotionally triggering nature of WB conversations. After learners received a brief orientation to simulation expectations and introduction to the case scenario, interprofessional student teams of three

Table 1: Demographics of learners by delivery phase

Characteristics	Phase I (*N* = 35)	Phase II (*N* = 43)	Phase III (*N* = 36)
	N (%)	*N* (%)	*N* (%)
Gender			
Male	14 (40)	11 (26)	7 (19)
Female	21 (60)	31 (72)	29 (81)
Unknown	0	1 (2)	0
Programme study			
Medical school		13 (30)	11 (31)
Nursing		13 (30)	5 (14)
Pharmacy		10 (23)	3 (8)
Health professions	35 (100)	7 (16)	14 (39)
Public health			3 (8)
Age, years (mean, SD)	25.46 (2.81)	24.77 (3.08)	24.64 (3.09)

to four members had 10 minutes to draft a treatment plan before beginning a 10-minute interaction with the patient to refine the plan and counsel the patient accordingly. A debriefing session including the student participants, SPs and faculty facilitators used a plus-delta approach [16] for students to reflect on the strengths and opportunities of the interaction, provided feedback from faculty and SPs. SP feedback focused primarily on learner communication, empathy, relational engagement and the perceived impact of learner interactions from the patient perspective. SPs also shared personal lived experiences related to WB in healthcare as part of the facilitated debriefing process to reinforce patient-centred reflection and perspective-taking. Psychological safety strategies for SPs included advance discussion of emotional triggers, normalisation of emotional responses, permission to pause participation if needed and active faculty support throughout implementation. Following simulation activities, SPs participated in debriefing discussions with faculty and simulation educators to reflect on learner interactions and emotional impact associated with participation. Upon completion of debriefing, two registered dieticians led a 10-minute presentation on the effects of WB on patient health outcomes and how to counsel patients with overweight and obesity, utilising the health-centric medicine model.

Each SP portrayed the same role repeatedly across multiple learner encounters and participated in one to three educational sessions overall. SPs interacted with multiple interprofessional learner teams consisting of three to four students per scenario. Consistency across sessions was supported through standardised case materials, structured preparation sessions, faculty review of expected role portrayal and ongoing communication between faculty, simulation staff and SPs throughout implementation. While maintaining fidelity to core learning objectives, SPs were encouraged to respond authentically to learner communication and relational approaches.

Phase III implementation: simulated patient encounter with cofactor consideration

To further develop learner understanding, instructors added thematic content that aligns with and informs WB considerations. The Phase III implementation incorporated defining and evaluating the impact of food insecurity on patients' nutritional decisions in addition to Phase II content. This case education included an assessment tool 'SEARCH' (Screen, Educate, Adjust, Recognize, Connect and Help) [17] to practice identification of food insecurity in the patient encounter. This content was intended to reinforce the importance of a holistic approach to patient care interviews and support skills that move beyond perceived visible evidence of nutritional decisions. Phase III events were delivered virtually via Zoom following adjustment for COVID-19 and development of telehealth simulation models. Analysis for the activity mirrored Phase II implementation and added items for two learning objectives related to food insecurity.

The interdisciplinary case creation team included faculty and educators from IPE, pharmacy, physician assistant education and dietetics. Several authors had expertise in simulation-based education, standardised participant methodology, communication training and interprofessional learning. Members of this team were directly involved in curriculum development, SP recruitment and preparation, facilitation of simulation sessions and learner debriefing. Given the sensitive nature of WB in healthcare, SP perspectives and lived experiences were intentionally incorporated throughout scenario refinement and implementation to support authenticity, psychological safety and patient-centred learning.

Evaluation of efficacy of learning formats

Phase I students completed a validated survey before and after the respective learning activity [18]. The survey was used to assess student perceptions of WB, perceived treatment outcomes of obesity and perceived causes of obesity using 5-point Likert scale responses (1 = strongly disagree, 5 = strongly agree). In addition to the survey instruments used in Phase I, students participating in Phase II also completed the pre- and post-assessment Interprofessional Collaborative Competency Attainment Survey (ICCAS) consisting of 20 questions that measure perceived skill for six performance domains: communication, collaboration, roles and responsibilities, collaborative patient- and family-centred approach, conflict management/resolution and team functioning using a 7-point Likert scale [19]. The post-assessment for Phase II also added a 5-point Likert learner evaluation of simulation delivery for items regarding simulation methodology, interprofessional learning goals and overall impression of the activity. Qualitative data were collected with two open response questions, *What aspects of the learning experience did you find most valuable?* and *Please share any other comments about this learning activity.* Qualitative analysis of the open responses submitted was intended to incorporate an 'organic and rich description from student comments regarding learning' [20]. Participant demographics (age, gender, race, current weight, height and programme of study) were also collected. Analysis for the Phase III activity mirrored the ICCAS, simulation methodology, interprofessional learning goals and overall impression items of Phase II implementation. Perceived causes of obesity items were pared down to four items. In conjunction with two learning objectives related to food insecurity that were added in Phase III, two intention items and one item reflecting perceived influence of food price on obesity were added to the post-evaluation.

Statistical analysis

Quantitative data analysis

Descriptive statistics of participants' demographic characteristics were calculated separately for each of the three study phases. Categorical variables were summarised as frequencies and percentages. Continuous variables were summarised as means with standard deviations (SD). For each study phase, the change in the attitudes and beliefs survey scores from pre- to post-intervention was calculated for each question using a 5-point Likert scale. In addition,

the average score across five questions was calculated for each participant and analysed using the same method. Composite scores were also derived for specific domains: external domain (questions 1, 2 and 4), introspective domain (questions 3 and 5), ability domain (questions 3 and 4) and character domain (questions 1 and 2). To compare changes between phases, changes in pre–post scores and composite scores in Phase II and Phase III were compared with those in Phase I (traditional lecture group), respectively. The between-phase comparisons were performed using the two-sample Wilcoxon sum test. The ICCAS scores were evaluated based on mean score on a 7-point Likert scale, with higher scores indicating greater agreement. The percent of scale difference (percent of maximum difference) was calculated to reflect post- vs. pre- score change. The evaluation of the Simulation Delivery Format was summarised using mean scores on a 5-point Likert scale, with higher scores indicating greater agreement. All statistical analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC, USA). A two-sided p-value <0.05 was considered statistically significant.

Qualitative data analysis

Qualitative analysis was conducted including learner statements from two open-ended questions. Response statements were compiled into a database for analysis. A constant comparative approach with open coding was used to define themes [21]. The student statements were independently reviewed by two separate coders to identify keywords or phrases to define themes. Discussion between coders regarding themes enabled consensus for categorisation and subsequent themes. Coders met regularly to resolve any discrepancies.

Results

Demographics of learners

One hundred and seventeen learners participated in the weight-bias training offerings (Phase I, n = 36; Phase II, n = 44; Phase III, n = 37) (Table 1). One participant was excluded due to invalid survey responses (Phase II, n = 43) and one from each phase due to incomplete survey completion in Phase I (n = 35) and Phase III (n = 36). Mean age was similar across groups. There was a higher proportion of females throughout the groups (70% overall). In Phase III, students from the College of Health Professions included physician assistant studies (3), speech-language pathology (1), respiratory care (1), genetic counselling (2), radiographic imaging sciences (3) and dental hygiene (4). From the College of Nursing family nurse practitioner, doctor of nursing practice and Bachelor's of Science in nursing students participated in Phase II and III.

Learner assessment

Perceived treatment outcomes of obesity

Perceived treatment scores increased post-intervention for all questions for Phase II and III IPE groups, indicating a positive change in learners' perceptions. Only three questions (Q1, Q2 and Q4) had higher post-scores for the Phase I (lecture) group. For most of the grouped questions in perceived treatment outcomes of obesity scale, there were significant score gains after intervention for IPE groups compared with lecture group including external, introspective, ability and character domains (Table 2).

Interprofessional collaborative competency attainment survey (ICCAS)

Table 3 reflects ICCAS mean scores before and after participation in the simulation. In Phase II there was a global improvement in ICCAS scores on event completion compared with pre-assessment, with change ranging 4.2% to 12.2%. Overall mean change was 9.3%. Phase III scores varied across competency items with change ranging −3.9% to 6.2%. There was no overall mean change. Items evaluating the simulation learning format are shown in Table 4. All items reflect agreement that the format was effective with mean scores ranging from 3.9 to 4.7 out of 5 possible though scores for the in-person Phase II delivery were higher for all items as compared to the virtual Phase III events.

Learners reflected that 'facilitator demonstrated interprofessional teamwork' and SPs 'portrayed the role well' with scores of 4.7 and 4.5, respectively. Students agreed 'I feel more comfortable in my ability to understand weight bias than I did prior to this activity' and 'this activity demonstrated the value of providing team-based weight and health training' with mean scores of 4.6 for both items in Phase II and 4.2 and 4.3 for Phase III, respectively. Items added to evaluate the incorporation of food insecurity as a social determinant of health consideration in Phase III were also positive with the majority of learners selecting 'strongly agree' or 'agree' that 'I feel more comfortable in my ability to assess for food insecurity than I did prior to this activity' (86%), 'this activity increased my knowledge about the efforts clinicians can make to address the health and disease management of those experiencing food insecurity' (89%), 'I intend to apply SEARCH (Screen, Educate, Adjust, Recognize, Connect and Help) to my clinical practice' (89%) and 'I intend to incorporate food insecurity related research and practice in my career' (86%).

Regarding the psychological safety of the Phase II in-person debriefing environment, 100% of learners 'strongly agreed' or 'agreed' that facilitators/SPs 'gave constructive feedback about specific behaviours', 'gave feedback without negative emotion' and 'contributed to a safe learning environment'. Psychological safety was also high for the Phase III virtual delivery format, with respective percentages of 97%, 92% and 92% indicating 'strongly agree' or 'agree' for the same items. General satisfaction with the activity was positive with 98% of learners in Phase II and 81% in Phase III noting they 'strongly agree' or 'agree' that 'Overall, I believe this was a valuable education activity'.

Qualitative analysis of responses to the question 'What aspects of the learning experience did you find most valuable?' included several themes: practice teamwork skills, appreciated simulation methodology, realistic, including simulated patient (SP), appreciated opportunity to increase knowledge of WB/food insecurity

Table 2: Comparison of the score changes of the perceived treatment outcomes of obesity scale questions (subsection 2) between IPE and lecture groups

Items	Phase I – lecture[a] (*n* = 35)	Phase II – IPE sim[a,e] (*n* = 43)	Phase III – IPE sim with cofactor[a,e] (*n* = 36)
	Difference of pre- and post-score (Post-Pre)[d] Mean (SD)	Difference of pre- and post-score (Post-Pre)[d] Mean (SD)	Difference of pre- and post-score (Post-Pre)[d] Mean (SD)
Single questions[b]			
Q1 In general, how compliant do you think obese patients are with treatment recommendations?	0.35 (0.73)	0.60 (0.83)	0.83 (0.87)**
Q2 In general, how motivated do you think obese patients are to change their diet?	0.53 (0.86)	0.74 (0.86)	0.69 (0.89)
Q3 How much confidence do you have that obese patients can maintain weight loss, once it is achieved?	–0.22 (0.86)	0.16 (0.84)*	0.19 (0.86)*
Q4 In general, how successful do you think obese patients can be in making behaviour changes?	0.09 (0.71)	0.26 (0.80)	0.42 (0.81)*
Q5 How much would you enjoy/do you enjoy counselling and working with obese patients?	–0.03 (0.76)	0.64 (0.82)***	–
Q6 Please rank the factor 'Pricing of foods (e.g., inexpensive unhealthy foods, more expensive healthier foods)' in terms of how important you think it is in causing obesity	–	–	–0.03 (0.70)
Grouped questions[c]			
Average of five items (Q1–Q5)	0.12 (0.54)	0.49 (0.47)***	–
Average of five items (Q1–Q4, Q6)	–	–	0.40 (0.58)
External (Q1, Q2, Q4)	0.31 (0.61)	0.53 (0.58)*	0.65 (0.66)**
Introspective (Q3, Q5)	–0.12 (0.52)	0.40 (0.59)***	–
Ability (Q3, Q4)	–0.09 (0.65)	0.21 (0.63)*	0.31 (0.70)**
Character (Q1, Q2)	0.44 (0.75)	0.67 (0.70)	0.76 (0.77)*

a Lecture, traditional lecture group; IPE Sim, interprofessional simulation group; IPE Sim with cofactor, interprofessional simulation group with food insecurity added to case.
b Range 1 to 5 (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).
c The scores for the grouped questions are the average scores of different questions.
d The difference of the pretest score and posttest score was calculated by subtracting the pretest scores from the posttest scores within each group.
e The average of the score difference of the Phase II or Phase III simulation group was compared with the average of the score difference of the lecture group using two-sample Wilcoxon rank-sum test.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

content and resources, appreciation for health centric focus, interaction with other professions, appreciated feedback/debrief, practice communication skills including patient-centred communication, appreciated emphasis to deconstruct biases, appreciation for lived experiences shared and enjoyable, valuable, great experience (Table 5). Representative quotes for several themes are provided in Table 5. Themes derived from the open-ended response for 'Please share any other comments about this learning activity' echoed themes from those cited as most valuable and added considerations for time assignment for different stages of the simulation. There were a few isolated comments that added considerations for future iterations of the simulation. Three students felt their discipline did not have a clearly defined role (genetic counselling and radiographic imaging sciences). Two students desired more information in the case details and four students suggested adding more time.

Discussion

Addressing WB in healthcare professionals is essential to ensure equitable and high-quality healthcare for all. Negative biases pertaining to patient weight are prevalent and does impact patient outcomes [22–26]. One of the strategies to combat this is effective education for healthcare professional students regarding issues around WB to affect culture change [24,26]. Despite this, education addressing WB is rare [25]. We describe the longitudinal development of an educational programme to address WB in healthcare professional students. This progressed from lecture-based education for uniprofessional students through interprofessional simulated scenarios with simulated patients, culminating in a simulated scenario in which cofactors to WB, that is, food insecurity were considered. We demonstrate that these educational offerings were effective in addressing biases in students,

Table 3: Comparison of ICCAS Scores (pre [mean], post [mean], % scale difference) for Phases II and III

	Phase II			Phase III		
	Pre	**Post**	**% scale diff**	**Pre**	**Post**	**% scale diff**
COMMUNICATION						
1. Promote effective communication among members of an IP team*	5.7	6.3	8.6	6.2	6.3	1.1
2. Actively listen to IP team members' ideas and concerns	6.3	6.6	4.2	6.7	6.5	–2.8
3. Express my ideas and concerns without being judgemental	6.0	6.4	6.1	6.6	6.3	–3.9
4. Provide constructive feedback to IP team members	5.4	6.2	11.6	6.2	6.3	1.2
5. Express my ideas and concerns in a clear, concise manner	5.6	6.3	10.7	6.3	6.3	–0.9
COLLABORATION						
6. Seek out IP team members to address issues	5.6	6.3	11.2	5.9	6.4	6.2
7. Work effectively with IP team members to enhance care	5.7	6.4	9.8	6.5	6.4	–1.7
8. Learn with, from and about IP team members to enhance care	5.8	6.4	8.4	6.6	6.5	–1.4
ROLES AND RESPONSIBILITIES						
9. Identify and describe my abilities and contributions to the IP team	5.5	6.3	12.2	6.3	6.3	0.3
10. Be accountable for my contributions to the IP team	6.0	6.4	6.5	6.5	6.5	–1.0
11. Understand the abilities and contributions of IP team members	5.7	6.4	10.1	6.5	6.4	–1.3
12. Recognise how others' skills and knowledge complement and overlap with my own	5.8	6.6	10.5	6.6	6.4	–1.8
COLLABORATIVE PATIENT/FAMILY-CENTRED APPROACH						
13. Use an IP team approach with the patient** to assess the health situation	5.5	6.4	12.2	6.4	6.4	0.2
14. Use an IP team approach with the patient to provide whole person care	5.6	6.4	11.9	6.4	6.3	–1.7
15. Include the patient/family in decision-making	5.9	6.6	8.9	6.5	6.6	0.7
CONFLICT MANAGEMENT/RESOLUTION						
16. Actively listen to the perspectives of IP team members	6.2	6.6	5.8	6.6	6.5	–1.0
17. Take into account the ideas of IP team members	6.1	6.5	5.8	6.7	6.7	0.1
18. Address team conflict in a respectful manner	5.9	6.5	8.8	6.6	6.4	–1.8
TEAM FUNCTIONING						
19. Develop an effective care*** plan with IP team members	5.6	6.3	10.7	6.3	6.3	–0.3
20. Negotiate responsibilities within overlapping scopes of practice	5.5	6.3	12.1	6.4	6.3	–1.7

*The patient's family or significant other, when appropriate, are part of the IP team.
**The word 'patient' has been employed to represent client, resident and service users.
***The term 'care' includes intervention, treatment, therapy, evaluation, etc.
Note: The percentage scale difference was summarised as the change in score relative to the maximum possible score: [(Post score – Pre score)/7] * 100.

Table 4: Learner evaluation of simulation delivery format (mean of five possible)

Simulation and case discussion	Phase II	Phase III
The learning experience:		
was valuable.	4.6	4.0
helped me apply my knowledge.	4.6	3.9
helped me gain confidence.	4.5	3.9
developed my communication skills.	4.5	3.9
developed my reasoning skills.	4.5	4.0
developed my decision-making ability.	4.4	4.0
was helpful in my development as a professional.	4.6	4.1
was helpful in my personal development for weight bias and food insecurity principles.	4.3	4.1
Facilitator(s) made me feel at ease during the case discussion.	4.6	4.2
Reflection on my performance helped me to learn.	4.6	4.0
Learners were actively engaged in the case discussion.	4.7	4.1
I learned strategies for improving performance.	4.5	4.1
Important steps to apply to future practice were summarised.	4.5	4.1

Table 5: Results of qualitative analysis of learner responses to the question: what aspects of the learning experience did you find most valuable?

Theme	Representative quotes
Practising skills: • teamwork skills • communication skills including patient-centred communication	'I loved that we were able to collaborate as a team'. 'Working with the team to come up with a plan for the patient'. 'I was reminded the importance of meeting the patient where they are in their health journey, and encouraging them throughout their progress to meet their goals'.
Educational structure: • simulation methodology, realistic, including SP • feedback/debrief • interaction with other professions	'The SPs were a good addition to the simulation. Having real feedback from case appropriate SPs helped me learn how to engage in gentle manner for future patients'. 'I enjoyed hearing from other healthcare professionals and their individual perspectives'.
Educational content: • opportunity to increase knowledge of weight bias/food insecurity content and resources • health centric focus • emphasis to deconstruct biases • lived experiences shared	'The conversation on weight bias. A lot of points I hadn't thought about before'. 'I think the best and most valuable part was hearing real life examples from the SPs and how negatively impacted them'. 'S.E.A.R.C.H. and learning ahead of time if there is food insecurity. Growing up in a small, rural town, I always knew that people were not necessarily obese because they lack control, but because they were in food deserts and the closest places to them were fast foods. Incorporating this into different populations no matter what career field you pursue touches on those social determinants and equities that are often left out of a holistic approach'. 'I found the information about food insecurity very valuable. I have not learned about this necessarily in my field but this course taught me the importance of asking individuals the questions in regard to it. Not only just asking the questions but learning how to ask them in an empathetic manner'.
Enjoyable; great experience; valuable	'LOVED This! Very Valuable'. 'I loved this experience'.

with the simulation components being most effective. When the content of the education also addressed a contributing factor to patients' weight, we were able to demonstrate the greatest improvement in healthcare professional student perceptions. Likely this is due to the fact that the students were pushed to higher levels of Bloom's taxonomy [26], that is, synthesis and evaluation, within this educational event having to reflect on action and critically think about relationships between patients, weight, food insecurity and food deserts. This contributing factor was selected as Arkansas has the highest rate of food insecurity in the United States for the last three consecutive years and it was therefore significantly applicable to our patient population [27]. The cofactors selected locally could vary, depending upon state and local patient population.

We observed differences in efficacy between the in-person and virtual formats. The Phase II education was delivered in person, however, Phase III (with cofactor

education) was delivered virtually to support participation of students at a distance campus. We did notice a reduction in the learner evaluation of the events for the virtual scenarios, and this may be related to the impact of the virtual environment on psychological safety. It is challenging to emulate the psychological safety of an in-person event for virtual simulations and especially for topics that may be or sensitive, such as WB, poverty and mental health [22]. Additionally, in the virtual delivery format, it is arguably more difficult to conduct telehealth format visits for issues of a more sensitive nature (e.g. providing a non-judgemental approach to obesity and identifying/addressing food insecurity) where development of rapport is perhaps more critical, and these learner evaluations may reflect both learner rapport as well as rapport developed with patient. Both faculty and SPs perceived that virtual delivery reduced emotional connection, rapport development and interpersonal impact during sensitive conversations surrounding WB and food insecurity compared to in-person implementation. Based on this feedback, the virtual format of the case will not be continued for future iterations of the curriculum. However, faculty and SPs have been trained to deliver the case in-person at the distance campus to support availability of the training to that cohort of students.

Healthcare educators should be aware of the benefits of formal education to address WB, and the efficacy of the modalities we describe. To affect a cultural change, we need to educate our upcoming healthcare professionals. Often in simulation education, when addressing topics that are sensitive such as this, there may be a tendency for healthcare educators to shy away from creating events. Simulation addressing sensitive topics may be particularly impactful, despite educator hesitancy. We describe an effective way to incorporate WB education into simulation education and a strategy by which to tailor this to the local patient population by adding cofactor education to improve learners' critical thinking. The learners appreciated this, highlighting 'you don't know what you don't know until it is put in front of you'. Importantly, SPs also reported that participation aligned with their goals for the educational activity and that the scenarios resonated with their own lived experiences related to WB and stigma in healthcare. SPs described valuing the opportunity to contribute to the development of more empathetic and patient-centred healthcare professionals. They additionally observed meaningful learner reflection and increased awareness during the encounters and debriefings. Several SPs expressed interest in continued participation in future sessions addressing sensitive healthcare communication topics. The educational events were well received by learners who appreciated the opportunity to work as interprofessional teams, practice communication and importantly, the content – specifically addressing bias in healthcare – mentioning that they had not previously had this addressed.

In conclusion, interprofessional simulation addressing WB may positively influence healthcare learners' explicit attitudes and attribution beliefs regarding patients with obesity, thus helping to mitigate WB. Integration of social determinants of health within simulation may further enhance contextual understanding and perspective-taking. Simulation educators should consider structured, psychologically safe approaches to addressing stigmatised topics central to equitable healthcare delivery.

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Declarations

Authors' contributions

KJD, KKN: conceptualisation, methodology, software, data curation and analysis, writing – original draft preparation, reviewing and editing, visualisation, investigation, supervision. TWH, HT, NAC, KGR: conceptualisation, writing – reviewing and editing. JJ: data analysis, writing – reviewing and editing.

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Ethics approval and consent to participate

The local Institutional Review Board granted an exception for this work as the information was collected as part of routine programmatic evaluation. Informed consent was not applicable to this process for that reason.

Competing interests

None declared.

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