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Team-Based Learning Intervention to Improve Obesity Education in Medical School

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Abstract

Introduction: Obesity is a multifactorial chronic disease and a major contributor to numerous health conditions. Despite the high prevalence, costs, and health effects of obesity, physicians are largely unprepared to treat it. Most medical students and residents lack sufficient training in obesity and obesity management. **Methods:** We evaluated a two-part team-based learning seminar (TBL) on obesity pathogenesis and treatment for first-year medical students at Case Western Reserve University School of Medicine (CWRU SOM). A questionnaire on attitudes toward obesity and self-perceived knowledge of obesity was administered before and after the TBL, utilizing Likert scales. **Results:** Of 183 medical students who attended both TBLs, 155 (85%) completed the baseline questionnaire, and 127 (69%) completed the postintervention questionnaire. Confidence in treating obesity increased significantly from preintervention ($M = 2.7$, $SD = 1.0$) to postintervention ($M = 3.7$, $SD = 0.8$). The attitude that obesity is caused by poor personal choices decreased significantly from preintervention ($M = 2.8$, $SD = 0.9$) to postintervention ($M = 2.1$, $SD = 0.9$). Self-perceived knowledge of obesity in all nine areas—epidemiology, energy homeostasis, etiologies, nutrition, physical activity, behavior, pharmacology, surgery, and language—increased significantly. **Discussion:** Despite obesity being one of the most prevalent health concerns, obesity education in medical school is scant. This TBL resulted in improved attitudes toward obesity and self-perceived knowledge of obesity among first-year medical students at CWRU SOM and offers a practical mechanism to introduce more obesity education into undergraduate medical curricula.

Keywords

Competency-Based Medical Education (Competencies, Milestones, EPAs), Curriculum Development, Internal Medicine, Nutrition, Team-Based Learning

Educational Objectives

By the end of this session, learners will be able to:

1. Describe the epidemiology of overweight and obesity and health disparities seen across populations.
2. Define the complex disease of obesity, its biological basis, and its pathophysiology.
3. Identify the goals in treating obesity.
4. Outline the obesity treatment continuum, including lifestyle, behavioral, pharmacological, and surgical approaches.
5. Practice working in a team setting to discuss the chronic disease of obesity using person-first language and avoiding weight bias.

Introduction

The prevalence of obesity, a complex chronic disease, continues to rise. Today, at least 41.9% of the US adult population has obesity.[1] In 2019, the medical cost of obesity in the US was estimated to be $173 billion.[2] Obesity is one of the largest contributors to the burden of chronic diseases like heart disease, hypertension, and diabetes.[1]

Despite the costs associated with obesity, physicians lack education in obesity and obesity management.[3] The Association of American Medical Colleges recognized the need for this training more than a decade ago, stating in 2007 that "medical education must assure that future physicians will be better

prepared to provide respectful, effective care of [patients with overweight and obesity].”[4] Despite this long-standing recommendation, little progress has been made on improving obesity education.[5] A 2020 study on the state of obesity education in undergraduate medical education found that only 10% of medical schools reported their students as “very prepared” to treat patients with obesity.[3]

Interventions to improve the quality of obesity education are crucial to the provision of quality obesity care from future physicians. Team-based learning (TBL) is an active learning strategy used in medical education to increase engagement, foster collaboration, and promote higher-order content learning.[6] The cases in a TBL provide students with the opportunity to practice clinical problem-solving as a team. Ours is the first curriculum development project to date that implements and evaluates an obesity TBL intervention in the preclinical undergraduate medical education setting. Prior obesity TBLs have been implemented with some success but only in the clerkship setting.[7,8] In this curriculum development project, we implemented and evaluated a two-part TBL seminar on obesity pathogenesis and treatment for students in the first-year medical student cohort at Case Western Reserve University School of Medicine (CWRU SOM). The first 2-hour TBL focused on obesity pathogenesis, and the second 2-hour TBL focused on obesity treatment. The learning objectives were based on the Obesity Medicine Education Collaborative competencies for health care professionals, chosen based on relevance to the TBL topics.[9] TBL 1 addressed Educational Objectives 1, 2, and 5; TBL 2 addressed Educational Objectives 3-5. We assessed the short-term impact of these TBLs on medical student attitudes toward obesity and self-perceived knowledge of obesity.

Methods

This curriculum development project was conducted at CWRU SOM in Cleveland, Ohio, and was exempted by the Case Western Reserve University Institutional Review Board. The TBLs were implemented during block 3 of the CWRU SOM curriculum, which focused on the gastrointestinal system, biochemistry, metabolism, and nutrition. Students were familiar with the TBL format as they participated in 13 other TBLs throughout the first year of medical school. Although there were some nutrition and obesity-related curricular activities at other points during the preclinical curriculum, this was the only setting in the curriculum where students received comprehensive instruction on obesity pathogenesis and treatment. The TBLs did not require any prerequisite knowledge on behalf of students

other than the study of the preparation resources. Many of the facilitators had extensive background in obesity and obesity management, although this was not required to facilitate the TBLs.

Team Formation
The TBL teams were formed by medical school faculty through randomization by gender at the beginning of the academic year. The students had the same TBL teams for every TBL during the first 2 years of medical school. There were 31 teams, with six to seven first-year students in each team.

Description of Advance Preparation Resources
The advance preparation resources included session objectives, preparatory readings, and preparatory slides. These resources were made available to students 1 week prior to the first TBL.

TBL 1: Obesity Pathogenesis:

1. Schwartz, Seeley, Zeltser, et al., “Obesity Pathogenesis: An Endocrine Society Scientific Statement.”[10]
2. Kyle, Dhurandhar, and Allison, “Regarding Obesity as a Disease: Evolving Policies and Their Implications.”[11]
3. Kyle and Puhl, “Putting People First in Obesity.”[12]

TBL 2: Obesity Treatment:

1. American Association of Clinical Endocrinologists and American College of Endocrinology Comprehensive Clinical Practice Guidelines for Medical Care of Patients With Obesity—Endocrine Practice.[13]
2. Preparatory PowerPoint slides (Appendix A).

General Logistics of TBLs
Two 2-hour TBLs occurred on November 17, 2021, and January 19, 2022, for first-year medical students at CWRU SOM. The first TBL focused on the pathogenesis of obesity. It was held in person at the Health Education Campus at CWRU SOM. During this TBL, teams were split into two different rooms. Each TBL team had a designated table with sticky-note pads. The second TBL focused on obesity treatment. It was held over Zoom due to COVID-19 restrictions. During this TBL, each TBL team was provided a breakout room to collaborate in. Both TBLs were facilitated by a medical student, two professors in nutrition, and two obesity medicine physicians. Facilitators were equipped (with the aid of audiovisual equipment) with PowerPoint slides that followed the structure of the TBL and provided some supplemental information (Appendices B and C). Facilitators also received facilitator guides, which offered answers and explanations for the readiness

assurance tests and application exercises (Appendices D and E).

Description of Readiness Assurance Process

The first 10 minutes of each session started with an individual readiness assurance test (iRAT), in which students answered questions based on the preparation resources (Appendices F and G). The iRATs were available to download from Canvas. The iRAT for TBL 1 featured five multiple-choice questions, and the iRAT for TBL 2 featured six multiple-choice questions. Students marked their answers individually and did not receive feedback. Next, they discussed the multiple-choice questions with their TBL team until agreement was reached; this process was called the group readiness assurance test (gRAT). When the group members reached a consensus, they recorded their chosen answers in a Qualtrics form, which provided immediate feedback on whether their choice was correct or not. We allotted 15 minutes to complete the gRAT. Students were not permitted to use any resources during the iRAT or gRAT. The correct answers were then discussed for 10 minutes with the facilitators, allowing for discussion and questions among students. The iRAT/gRAT process was not graded.

Description of Team Application Activities

Students responded to application exercises based on case vignettes developed by three obesity medicine physicians and a second-year medical student. Students had around 15 minutes to discuss each exercise with their team. They then simultaneously revealed their answers using laminated letters, followed by a discussion with facilitators. Each TBL contained three application exercises available to download from Canvas. Students could access all resources during this portion of the TBL. During TBL 1, the application exercises focused on how to approach obesity, the multifactorial nature of obesity, and the pathogenesis of weight regain (Appendix H). During TBL 2, the application questions focused on the continuum of obesity treatment (Appendix I). The team application activities were not graded. At the end of each TBL session, we posted a document with take-home points on Canvas for students to review (Appendices J and K).

Facilitation Schema

Each TBL required 1 hour and 50 minutes, for a total of 3 hours and 40 minutes of instructional time for the combination of both TBL sessions:

- iRAT: 10 minutes.
- gRAT: 15 minutes.
- gRAT discussion with facilitators: 10 minutes.
- Application exercise 1: 15 minutes.
- Application exercise 1 discussion with facilitators: 10 minutes.
- Application exercise 2: 15 minutes.
- Application exercise 2 discussion with facilitators: 10 minutes.
- Application exercise 3: 15 minutes.
- Application exercise 3 discussion with facilitators: 10 minutes.

Evaluation

We administered a questionnaire on attitudes toward obesity and self-perceived knowledge of obesity before and after this educational intervention to gauge intervention-related changes (Appendix L). As there was no validated tool to measure medical student attitudes toward obesity and self-perceived knowledge of obesity, we created our own 19-point questionnaire after reviewing the existing literature. Using a 5-point Likert scale (1 = *strongly disagree,* 5 = *strongly agree*), respondents rated their extent of agreement with 10 items inquiring about attitudes toward obesity based on the NEW Attitudes Scale.[14] The remaining nine items inquired about obesity self-perceived knowledge and consisted of nine competencies based on the Medical School Curriculum Benchmark Study that were addressed in the TBL sessions.[3] Respondents were asked to rank their knowledge of each competency using a 4-point Likert-type scale (1 = *not at all knowledgeable,* 4 = *very knowledgeable*). The baseline questionnaire was completed in the week prior to the first TBL, while the postintervention questionnaire was completed in the week after the second TBL. Data were collected and managed using REDCap tools hosted at Case Western Reserve University.[15] We computed a composite self-perceived knowledge score (out of 36) by taking the sum of the obesity knowledge questions. Because responses were anonymous, baseline questionnaire data could not be paired with postintervention questionnaire data. Therefore, we used unpaired *t* tests to assess the short-term impact of this intervention. We compared mean composite knowledge scores, as well as mean scores on the individual knowledge and attitude items, from baseline questionnaire to postintervention questionnaire. Since a high number of hypothesis tests were being conducted, we decided a priori to use a conservative *p* value of <.01 to establish statistical significance. The literature guiding analysis of data generated from Likert scales is controversial; therefore, in addition to comparing means from the Likert-scale data, we calculated frequencies for each item. Analysis was conducted with SPSS Statistics version 28.

Results

Of the 183 first-year medical students who attended both educational sessions, 155 (85%) completed the baseline questionnaire, and 127 (69%) completed the postintervention questionnaire. Mean scores for attitudes toward obesity both before and after the intervention are presented in Table 1. Statistically significant improvement in attitudes toward obesity was seen in eight out of 10 categories. Notably, confidence in treating obesity increased significantly ($p < .001$) from preintervention ($M = 2.7$, $SD = 1.0$) to postintervention ($M = 3.7$, $SD = 0.8$). Desire to counsel patients about weight management increased significantly ($p < .001$) from preintervention ($M = 3.1$, $SD = 1.0$) to postintervention ($M = 3.5$, $SD = 1.0$). The attitude that obesity is caused by poor personal choices decreased significantly ($p < .001$) from preintervention ($M = 2.8$, $SD = 0.9$) to postintervention ($M = 2.1$, $SD = 0.9$). Figure 1 illustrates the frequency of each attitude response category before and after the intervention.

Mean scores for self-perceived obesity knowledge both before and after the intervention are presented in Table 2, and response category frequencies are presented in Figure 2. Self-perceived knowledge of obesity in all nine areas—epidemiology, energy homeostasis, etiologies, nutrition, physical activity, behavior, pharmacology, surgery, and language—increased significantly ($p < .001$). The composite obesity knowledge score increased significantly ($p < .001$) from preintervention ($M = 19.9$, $SD = 4.4$) to postintervention ($M = 28.2$, $SD = 4.4$). Because the TBLs were not graded, there was no record of how students performed on each component of the TBLs. There were no student evaluations of the TBLs.

Discussion

Despite obesity being the most prevalent chronic disease, there remains a lack of obesity training in medical education. Few studies evaluate curricular components for obesity education in undergraduate medical curricula. This two-part obesity TBL written by the curriculum development team resulted in improved attitudes toward obesity and improved self-perceived knowledge of obesity among first-year medical students at CWRU SOM and offers a practical mechanism to introduce more obesity education into undergraduate medical curricula.

The few similar educational initiatives that have been conducted show similar results. Velazquez and colleagues created a 2.5-day obesity workshop for residents and fellows and found that it resulted in improved obesity knowledge and competence.[16] Kushner and colleagues developed an obesity educational intervention involving standardized patients for first-year medical students and found that an encounter with a standardized patient with overweight or obesity resulted in a long-term increase in empathy and confidence in counseling skills.[17]

We encountered several challenges through the process of developing and implementing this new resource. We quickly learned that a collaborative effort was paramount. The synergy of our diverse and multidisciplinary team played a pivotal role in the successful implementation of these TBLs. In addition, choosing what to include in the TBLs was a challenge in prioritization. It required a focused distillation of a wide range of obesity medicine content into two succinct modules tailored specifically for the first-year medical student. Finally, given the relatively new

Table 1. Student Obesity Attitude Scores

Item[a]	M (SD)		p
	Baseline[b]	Postintervention[c]	
Obesity is a disease.	4.3 (0.7)	4.7 (0.6)	<.001
Obesity is caused by poor personal choices.	2.8 (0.9)	2.1 (0.9)	<.001
I think patients with obesity are motivated to change their lifestyle.	3.5 (0.8)	4.1 (0.6)	<.001
I believe that my patients will follow through with a weight management program.	3.1 (0.7)	3.7 (0.6)	<.001
I believe patients can maintain weight loss.	3.6 (0.8)	3.9 (0.7)	<.001
I feel confident treating patients with obesity.	2.7 (1.0)	3.7 (0.8)	<.001
I feel effective in helping patients with obesity manage their weight.	2.7 (1.0)	3.8 (0.7)	<.001
I think treating patients with obesity is not worth the time.	1.3 (0.7)	1.4 (0.9)	.20
If a patient has obesity, I feel uncomfortable discussing their weight.	2.4 (1.0)	2.2 (0.9)	.07
I have a personal desire to counsel patients about weight management.	3.1 (1.0)	3.5 (1.0)	<.001

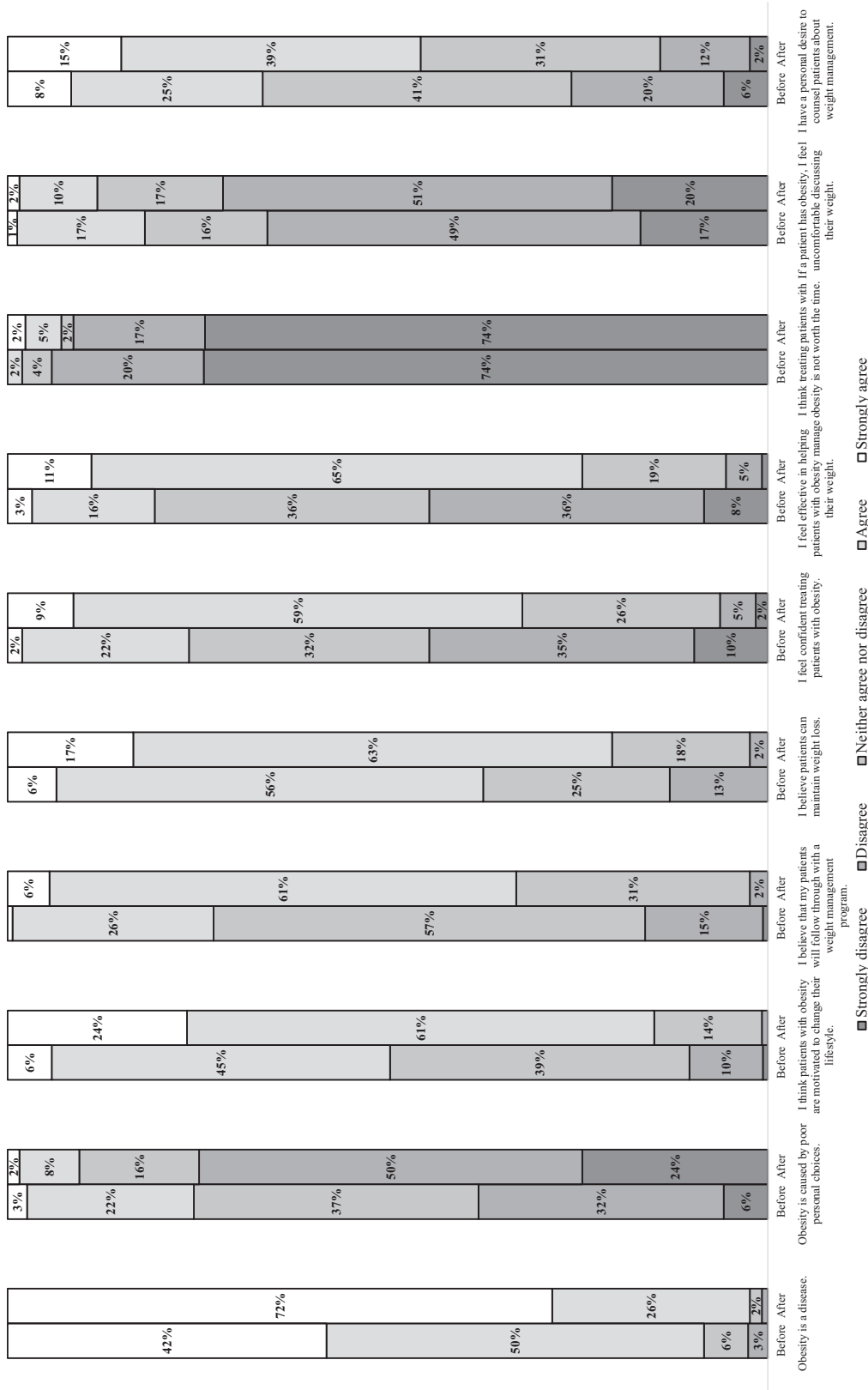[a]Rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).
[b]N = 115.
[c]N = 127.

Figure 1. Student attitudes toward obesity: baseline and follow-up response frequencies.
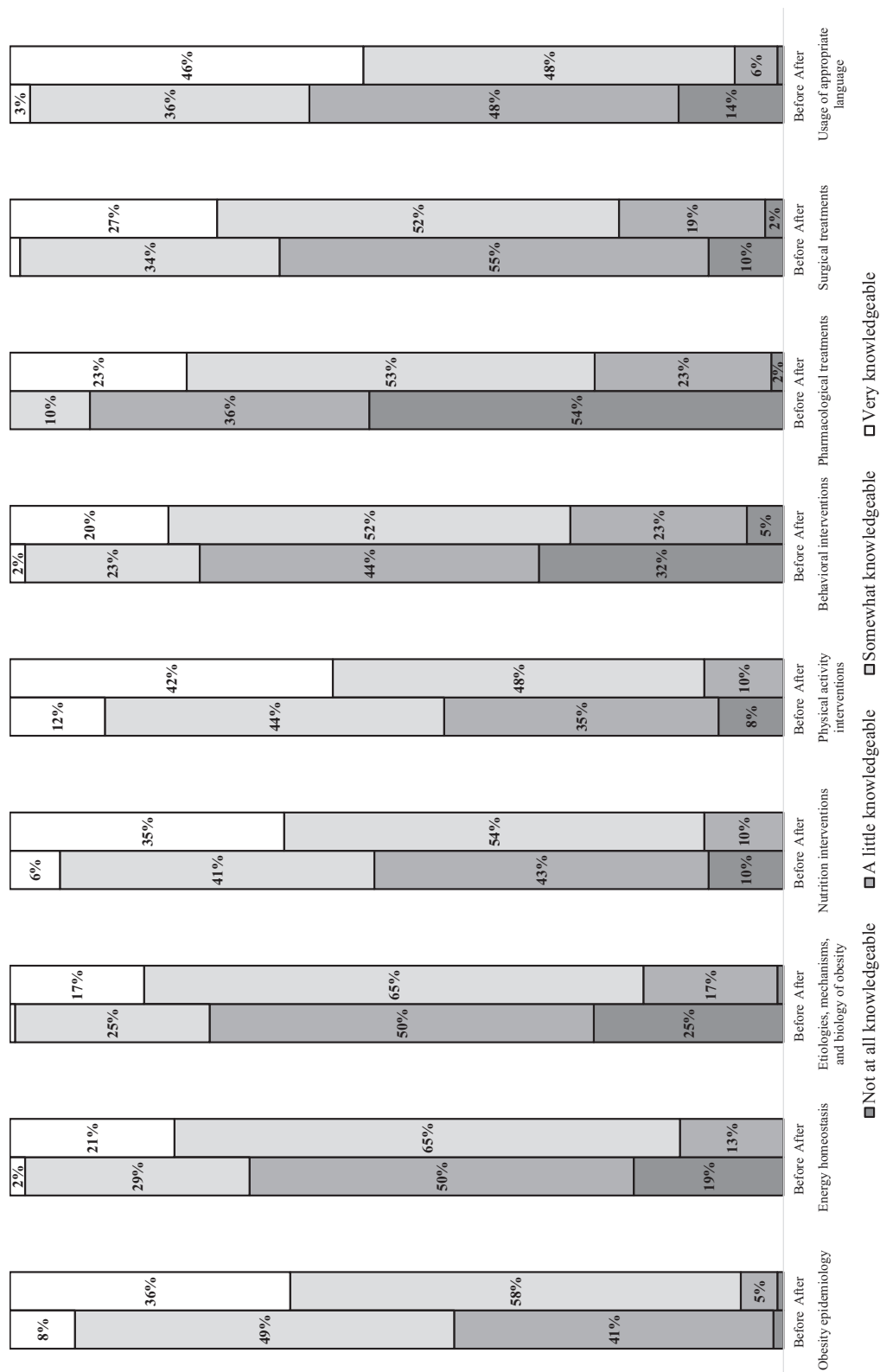
Legend: Strongly disagree ▪ | Disagree ▫ | Neither agree nor disagree ▪ | Agree ▫ | Strongly agree ▫

Obesity is a disease.
- Before: 42%, 50%, 6%, 3%
- After: 72%, 26%, 2%

Obesity is caused by poor personal choices.
- Before: 3%, 22%, 37%, 32%, 6%
- After: 2%, 8%, 16%, 50%, 24%

I think patients with obesity are motivated to change their lifestyle.
- Before: 6%, 45%, 39%, 10%
- After: 24%, 61%, 14%

I believe that my patients will follow through with a weight management program.
- Before: 26%, 57%, 15%, 2%
- After: 6%, 61%, 31%, 2%

I believe patients can maintain weight loss.
- Before: 6%, 56%, 25%, 13%
- After: 17%, 63%, 18%, 2%

I feel confident treating patients with obesity.
- Before: 2%, 22%, 32%, 35%, 10%, 2%
- After: 9%, 59%, 26%, 5%, 2%

I feel effective in helping patients with obesity manage their weight.
- Before: 3%, 16%, 36%, 36%, 8%
- After: 11%, 65%, 19%, 5%

I think treating patients with obesity is not worth the time.
- Before: 2%, 4%, 20%, 74%, 2%
- After: 2%, 5%, 2%, 17%, 74%

If a patient has obesity, I feel uncomfortable discussing their weight.
- Before: 1%, 17%, 16%, 49%, 17%
- After: 2%, 10%, 17%, 51%, 20%

I have a personal desire to counsel patients about weight management.
- Before: 8%, 25%, 41%, 20%, 6%
- After: 15%, 39%, 31%, 12%, 2%

Figure 2. Student self-perceived knowledge of obesity: baseline and follow-up response frequencies.

Legend:
- ■ Not at all knowledgeable
- ■ A little knowledgeable
- □ Somewhat knowledgeable
- □ Very knowledgeable

Usage of appropriate language
- After: 46%, 48%, 6%
- Before: 3%, 36%, 48%, 14%

Surgical treatments
- After: 27%, 52%, 19%, 2%
- Before: 34%, 55%, 10%

Pharmacological treatments
- After: 23%, 53%, 23%, 2%
- Before: 10%, 36%, 54%

Behavioral interventions
- After: 20%, 52%, 23%, 5%
- Before: 2%, 23%, 44%, 32%

Physical activity interventions
- After: 42%, 48%, 10%
- Before: 12%, 44%, 35%, 8%

Nutrition interventions
- After: 35%, 54%, 10%
- Before: 6%, 41%, 43%, 10%

Etiologies, mechanisms, and biology of obesity
- After: 17%, 65%, 17%
- Before: 25%, 50%, 25%

Energy homeostasis
- After: 21%, 65%, 13%
- Before: 2%, 29%, 50%, 19%

Obesity epidemiology
- After: 36%, 58%, 5%
- Before: 8%, 49%, 41%

Table 2. Student Self-Perceived Obesity Knowledge Scores

Item[a]	M (SD)		
	Baseline[b]	Postintervention[c]	p
Obesity epidemiology	2.7 (0.7)	3.3 (0.6)	<.001
Energy homeostasis	2.1 (0.7)	3.1 (0.6)	<.001
Etiologies, mechanisms, and biology of obesity	2.0 (0.7)	3.0 (0.6)	<.001
Nutrition interventions	2.4 (0.8)	3.2 (0.6)	<.001
Physical activity interventions	2.6 (0.8)	3.3 (0.7)	<.001
Behavioral interventions	2.0 (0.8)	2.9 (0.8)	<.001
Pharmacological treatments	1.6 (0.7)	3.0 (0.7)	<.001
Surgical treatments	2.3 (0.7)	3.0 (0.8)	<.001
Usage of appropriate language	2.3 (0.7)	3.4 (0.6)	<.001
Composite knowledge score[d]	19.9 (4.4)	28.2 (4.4)	<.001

[a]Rated on a 4-point Likert-type scale (1 = *not at all knowledgeable,* 4 = *very knowledgeable*).
[b]N = 115.
[c]N = 127.
[d]Computed by summing the obesity knowledge items.

recognition of obesity as a disease, it is noteworthy that a subset of students exhibited resistance to the concept of classifying obesity as a chronic disease. This challenge was overcome by the presence of expert facilitators who could explain the nuances of obesity and address student concerns during the TBL discussions. The replication of these TBLs at other institutions will likely require dedicated faculty with some expertise in obesity medicine.

There are several limitations to this curriculum development project. First, a new questionnaire was implemented. Although adapted from a validated tool, our questionnaire does not yet have established reliability or validity among this population or in this form. The questionnaire also relies on self-reported beliefs and knowledge, which may vary from actual attitudes and knowledge. It is also possible that students did not complete the prework, as the readiness assurance tests were not graded, in alignment with our curriculum's pass/fail philosophy. However, this limitation was partially mitigated by our school's rigorous standards for professionalism. Team members had high expectations for each other, fostering a culture of accountability in completing necessary prework. Finally, our project did not evaluate its long-term impact on student attitudes toward and knowledge of obesity. Future studies are warranted to evaluate the long-term impact of this seminar and to investigate the link between changed attitudes/knowledge and actual behavior as physicians.

Medical student attitudes toward obesity and self-perceived knowledge of obesity significantly improved after a two-part TBL on obesity pathogenesis and treatment. As TBLs are being increasingly utilized in medical curricula across the country, our resource provides a model to improve obesity education at the national level. Improved obesity education at the undergraduate medical level will create a generation of physicians who are more competent in obesity management, although more studies are needed to determine if changed obesity attitudes and knowledge in medical school result in improved obesity management as physicians.

Appendices

A. TBL 2 Preparatory Slides.pptx

B. TBL 1 Facilitation Slides.pptx

C. TBL 2 Facilitation Slides.pptx

D. TBL 1 Facilitator Guide.docx

E. TBL 2 Facilitator Guide.docx

F. TBL 1 iRAT Student Version.docx

G. TBL 2 iRAT Student Version.docx

H. TBL 1 Application Exercises.docx

I. TBL 2 Application Exercises.docx

J. TBL 1 Take-Home Points.docx

K. TBL 2 Take-Home Points.docx

L. Evaluation.docx

All appendices are peer reviewed as integral parts of the Original Publication.

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