

Preparing Medical Students to Facilitate Lifestyle Changes With Obese Patients: A Systematic Review of the Literature

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Abstract

Purpose

Doctors will increasingly encounter opportunities to support obese patients in lifestyle change efforts, but the extent to which medical schools prepare their students for this challenge is unknown. Further, despite evidence indicating theory-based techniques are effective in facilitating patients' behavioral changes, the methods taught to medical students and the means of content delivery are unclear. The authors reviewed the literature to investigate how effective educational interventions are in preparing medical students to facilitate lifestyle changes with obese patients.

Method

The authors systematically searched Excerpta Medica (EMBASE), PsycINFO,

MEDLINE, and Scopus for educational interventions on obesity management for medical students published in English between January 1990 and November 2010 and matching PICOS (Population, Interventions, Comparators, Outcomes, Study design) inclusion criteria.

Results

Results of a narrative synthesis are presented. Of 1,680 studies initially identified, 36 (2%) full-text articles were reviewed, and 12 (1%) were included in the final dataset. Eleven (92%) of these studies had quantitative designs; of these, 7 (64%) did not include control groups. Nine (75%) of the 12 studies were atheoretical, and 4 (33%)

described behavior management strategies. Despite positive reported outcomes regarding intervention evaluations, procedures to control for bias were infrequently reported, and conclusions were often unsupported by evidence.

Conclusions

Evidence from this systematic review revealed data highly susceptible to bias; thus, intervention efficacy could not be determined. Additionally, evidence-based strategies to support patients' obesity-related behavior changes were not applied to these studies, and thus it remains unknown how best to equip medical students for this task.

Obesity directly contributes to common long-term illnesses including type 2 diabetes, some cancers, and cardiovascular disease.^{1,2} In 2008, one in nine adults worldwide were considered obese (defined

as having a body mass index [BMI] ≥ 30 kg/m²).³ Obesity, which has been labeled a global epidemic,⁴⁻⁶ also leads to escalating financial consequences and increasing workloads for health care systems. Each year, one-sixth of the U.S. health care budget (approximately \$168 billion or £110 billion)⁷ and \$6.6 billion or £4.2 billion in the United Kingdom⁸ is spent on illnesses caused by obesity. Because initiatives to combat obesity are urgently needed in most countries,³ it is crucial to identify the most effective methods of obesity management, particularly those to which health care systems can make contributions.

This article's focus is on the prevention and control of obesity through behavioral management approaches (e.g., changes in diet and activity)^{1,9} rather than alternative methods (e.g., pharmacological or surgical interventions). Making sustained changes to obesity-related behavior is a notoriously difficult task, and success is influenced by various epidemiological and psychological factors.¹⁰⁻¹² Additionally, obesity is a socially sensitive subject with the potential to damage the patient-practitioner

relationship.¹³ Traditional knowledge-enhancing approaches within health care (in which patients are provided with only generic risk information) have been shown to be less successful in eliciting lifestyle changes than are methods that address specific determinants of patients' behavior defined within theoretical frameworks.^{1,14-16} Because the latter approach allows tested, targetable factors to be identified,¹⁷ health care governing bodies are increasingly recognizing that health-related behavior change interventions should be based on relevant theories.^{18,19}

Progress in the area of theory-based behavior change derives from a recently developed taxonomy that encompasses motivation, action, and organization theories²⁰ and associated effective behavior change techniques (e.g., motivational interviewing [MI], goal setting, and stress management).¹⁷ Thus, there is opportunity to develop educational interventions targeting these techniques; some efforts to do so have been successful, particularly with regard to training medical professionals

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to use MI without increasing overall consultation times.^{21,22}

Opportunities to discuss lifestyle changes are often missed, however.^{23,24} It is well documented that clinicians feel unconfident, unskilled, and uncertain about their specific roles and responsibilities in addressing behavior change with obese patients.^{1,13,25–27}

Research nonetheless suggests that patients want their doctors to take a more active role in encouraging them to change their diet and physical activity patterns,²⁸ and clinical guidelines recommend that physicians tackle obesity with patients through implementing tailored plans and exploring barriers to change.²⁹ Moreover, even though lifestyle change discussions are most effective when they are theory based,^{30,31} this approach is not yet used regularly in medical practice.³² Because medical education ultimately affects the quality of patient care and patient outcomes,³³ educators should consider how medical students are being prepared for the complex and increasingly common task of discussing behavior management strategies with obese patients.

Within the United Kingdom, Tomorrow's Doctors (2009)³⁴ stipulates that, as scholars and scientists, medical school graduates should be able to “discuss psychological aspects of behavioral change and treatment compliance” (section 9e) and, as practitioners, to “communicate appropriately in difficult circumstances, such as when breaking bad news, and when discussing sensitive issues such as alcohol consumption, smoking or obesity” (section 15d). Researchers also advocate training medical students in “patient activation” methods (such as MI), which stimulate patients to take responsibility for their own health, in order to create stronger pathways between medical education and meaningful patient outcomes.³³

Yet, areas of medicine encompassing obesity management (e.g., health promotion/preventive care) are poorly established within medical school curricula.^{35–39} Although many medical students view obesity management as an important aspect of the physician's role, their knowledge and satisfaction with associated education is significantly lower than that reported by student dietitians.⁴⁰ In one study, 60% of responding primary

care physicians reported that they had been provided with insufficient knowledge to be able to address unhealthy eating patterns with patients.⁴¹

Although these and other studies suggest a paucity of obesity-related education in medical schools,⁵ empirical investigations have not identified the extent to which current understanding of how to support patients' health-related behavior changes^{42,43} is represented within medical education, or what the most effective educational methods may be. We aimed to fill this gap by conducting a systematic literature review to investigate the following research question: How effective are educational interventions in preparing medical students to facilitate lifestyle changes with obese patients?

Method

Search strategy

In July 2010, one author (A.C.) conducted preliminary searches for relevant studies using key terms (e.g., *obesity*, *medical students*) within medical and social science databases. She refined these searches to identify studies that included literature reviews and searched the online Cochrane Library database, but she found no previously published systematic reviews on obesity management education for medical students.

Between July and November 2010, A.C. systematically searched the following

electronic databases for relevant studies: MEDLINE, Excerpta Medica (EMBASE), PsycINFO, and Scopus. In line with Centre for Reviews and Dissemination (CRD) recommendations,⁴⁴ we developed our search strategy using a PICOS (Population, Interventions, Comparators, Outcomes, Study design) format, which informed our search terms and inclusion criteria. The selected search terms were based on the target population, interventions (educational sessions for medical students addressing obesity-related behaviors/conditions), and outcomes (see List 1). We did not include terms related to comparators or study design because preliminary searches indicated that relevant studies would likely be omitted if interventions lacked control or comparison groups; thus, particular study designs would be excluded from the review. We combined search term sets (using *AND*) and exploded all search terms using the truncation (\$) and key word advanced search (article title, abstract, full text, and caption text [*.mp.*]) functions. We also set time frame limitations (publication date of January 1990 through November 2010) in line with emerging calls in the 1990s^{45,46} by health care governing bodies for the inclusion of health promotion and related subjects in the undergraduate medical curriculum. (The full search strategy is available from the authors.)

Initially, A.C. selected studies for inclusion by screening the titles and abstracts of all

List 1

Terms Used Within Systematic Review Search Strategy*

1. medical education/ or medical student/ or medical school
2. obesity/ or obes\$.mp.
3. weight gain/ or weight gain\$.mp.
4. weight manag\$.mp.
5. nutrition/ or nutrition\$.mp.
6. diet/ or diet\$.mp.
7. eating/ or eat\$.mp.
8. physical activity/ or jog\$/ or run\$/ or walk\$/
9. sedentary.mp.
10. diabet\$.mp./ or diabetes mellitus
11. paediatric\$.mp. or pediatric\$.mp.
12. heart disease/ or cardiovascular\$.mp.
13. knowledge\$.mp.
14. confiden\$.mp.
15. attitud\$.mp.
16. intention\$.mp.
17. performance\$.mp.
18. skill\$.mp.
19. 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12
20. 13 or 14 or 15 or 16 or 17 or 18
21. 1 and 19 and 20
22. limit 21 to (English language and yr="1990-Current")

*Search term key: \$ = truncation; .mp. = searches title, abstract, full text, caption text; current = November 2010.

Table 1

Inclusion and Exclusion Criteria for Systematic Review of the Literature on Educational Interventions for Medical Students Targeting Obesity Management

Category	Inclusion criteria	Exclusion criteria
Population	<ul style="list-style-type: none"> • Medical school students • Students may be school leavers or have obtained a university degree prior to medical school entry • Medical program may be any length • Other participant groups may feature within the sample 	<ul style="list-style-type: none"> • Medical trainees post medical school • Qualified health care professionals • Students of other health care professions (e.g., dieticians, nurses)
Interventions	<ul style="list-style-type: none"> • Educational interventions with the following content explicitly related to obesity: <ul style="list-style-type: none"> ◦ Obesity as a distinct topic ◦ Behaviors related to obesity/obesity management (e.g., exercise) ◦ Conditions related to obesity (e.g., diabetes) • Educational interventions with the following content (deemed as implicitly related to obesity): <ul style="list-style-type: none"> ◦ Increasing physical activity levels ◦ Decreasing fat/calorie intake ◦ Reducing body mass index (BMI) ◦ Weight loss 	<ul style="list-style-type: none"> • Intervention topics unrelated to obesity (e.g., malnutrition, general nutrition education) • Educational interventions aiming to improve students' health only, with no explicit link to improving patients' health
Comparators	<ul style="list-style-type: none"> • Studies with or without control/comparison groups 	<ul style="list-style-type: none"> • Not applicable
Outcomes	<ul style="list-style-type: none"> • Studies with at least one outcome measure and sufficient (quantitative or qualitative) data to describe intervention effects 	<ul style="list-style-type: none"> • Studies without any reported outcome data
Study design (and study features)	<ul style="list-style-type: none"> • Any design (except studies without outcome measures) • English language only • Published 1990–2010 • Published/conducted in any country 	<ul style="list-style-type: none"> • Insufficient detail to determine any study content

studies. Those with features not relevant to the review, such as studies that did not include medical students (e.g., samples of nursing students) or that were not related to obesity (e.g., malnutrition studies), were excluded at this point. Studies with titles/abstracts that presented ambiguous information or did not indicate key details (e.g., identity of the study population) were included so that relevant studies would not be missed. This process was carried out by a single author because study selection was intended to be overinclusive at this stage. A.C. also checked reference lists manually for additional relevant articles, contacted study authors when full study details could not be accessed, and removed duplicates. She then assessed full texts of the remaining articles for eligibility against full PICOS inclusion/exclusion criteria (Table 1).

To ensure reliability, a second coder (M.N.), who was not involved with the study, independently repeated the selection process using PICOS eligibility criteria for all of the full-text articles identified by A.C. Results from both coders were compared; the calculated interrater reliability statistics (Cohen $k = 0.89$) demonstrated “almost perfect”

agreement⁴⁷ for selection of studies into the final dataset.

Data extraction tools

We developed two tools to enable data extraction: one to identify descriptive data, the other to identify methodological features to inform coder judgments about the quality of the included studies. All authors contributed to the development of these tools through meeting regularly to discuss design issues and subsequent revisions. The preliminary searches indicated that the tools should account for quantitative and qualitative designs as well as studies that did not have robust experimental designs (e.g., those that were not randomized controlled trials). Hence, we drew relevant components (such as study aim, design, and sample) from existing extraction and quality assessment tools used within health care and public health research,^{44,48–51} rather than using any one previously developed tool. We did not, therefore, incorporate redundant components that were not relevant to studies within this review (e.g., blinding to participant group, which is not applicable to studies with only one participant group). Consultations with

experienced systematic review researchers (E.H. and another independent researcher, P.B.) further helped us determine which components should be selected so that the most salient information, relevant to the aims of this review, would be collected.

The final versions of our data extraction tools therefore incorporated the following components: Tool 1, for descriptive data, included study aim, sample, design, intervention content, intervention structure, outcome data, and conclusions. Tool 2, for methodological features, directed coders to evaluate the quality of studies according to three criteria:

- **Intervention transparency:** A study was deemed transparent if either the educational content of the intervention or the intervention evaluation procedures were described within the article. Where possible, coders noted whether descriptions were sufficient to allow for replication and compared notes to reach consensus.
- **Control for risk of bias:** A study was deemed to have attempted to control for bias if it explicitly described

measures to overcome potential confounders (i.e., secular trends/selection bias).

- Conclusions supported by sufficient evidence: Conclusions were deemed reliable if they were clearly described and did not reach beyond data and if the study design was robust. Coders used descriptive data regarding study designs to support these appraisals.

To test the tools' suitability, three authors (A.C., J.H., S.P.) piloted both tools on two studies and then discussed and dealt with arising queries as a group. For example, piloting indicated that the presence/absence of simple procedures to control for risk of bias (obtaining baseline measures, including control groups, randomization) should be explicitly coded for because some articles did not mention them.

Data extraction

One author (A.C.) completed data extraction using both tools for all articles included in the final dataset. To reduce risk of bias, her results were compared with independent ratings completed by three other research team members (J.H., K.M., S.P.), each of whom coded some articles. Thus, all included studies were second coded. Arising discrepancies were resolved through discussion, with a third team member acting as an arbitrator when necessary.

Results

A total of 1,680 articles were initially identified by searches and screened for relevance to the research question. Of these, 36 (2%) were reviewed against all eligibility criteria, resulting in 12 articles (1%) being selected for inclusion in the final dataset (Figure 1).

We present a narrative synthesis of the data because of the diversity of methodologies and outcome measures used within the 12 studies; this is in line with CRD recommendations for systematic reviews that are based on heterogeneous groups of studies.⁴⁴ Our findings lie within four categories: study characteristics, intervention structure and content, intervention outcomes and reported results, and risk of bias within studies.

Study characteristics

The 12 educational interventions that met eligibility criteria^{37,38,52–61} were published in a range of academic journals between 1993 and 2010 (6 [50%] within the last five years of this range), and most (n = 9; 75%) were conducted within the United States. Demographic details of study samples were often unreported; data on participant gender were included in 6 (50%)^{52,53,55,57,58,61} (range = 29%–74% female), and ethnicity was included in 2 (17%).^{54,57} One study (8%) had a qualitative design,⁶¹ whereas the other 11 (92%) employed the following quantitative designs: controlled trial (nonrandomized),^{53,54,56,57} before-and-

after study,^{38,58,59} or evaluation-only study (no preintervention data obtained).^{37,52,55,60} Of these quantitative-design studies, 7 (64%) did not, therefore, include control groups. Table 2 provides additional details about study characteristics.

Intervention structure and content

Educational interventions on obesity management varied widely in terms of their timing within medical school curricula (Table 2). Interventions occurred within ambulatory care blocks,^{37,38,53} preventive care modules,^{54,57} a first-year introductory course,⁵⁹ a second-year clinical placement,⁵⁵ a third-year family medicine clerkship,⁶⁰ a fifth-year addiction medicine course,⁶¹ or across four separate areas throughout the medical school curriculum.⁵⁶ Insufficient reporting prevented us from identifying this information in two studies (17%).^{52,58}

Appendix 1 shows the variety of health professionals involved in intervention delivery (this was unclear in four studies [33%]), as well as intervention durations (estimated student contact time: median = 20.75 hours, range = 1–99.3 hours). In terms of delivery, the inclusion of didactic sessions was common to most studies (n = 9; 75%)^{37,38,52–57,59}; other educational methods included classroom-based learning, opportunities to practice learned skills, assessment, self-monitoring, and experiential learning.

Whereas five studies (42%) were exclusively related to educational interventions on obesity and the behaviors that govern it,^{55,56,58,60,61} others included education on obesity-related illnesses such as cardiovascular disease and diabetes.^{52,53,55,57} Seven studies (58%) addressed additional health topics, such as smoking and alcohol.^{37,38,52–54,57,59} Despite targeting obesity as a distinct topic within interventions, eight studies (67%) did not describe the strategies provided to students to help them tackle this issue with patients.^{52–58,61} Instead, these reports focused on how interventions were delivered to students. Interestingly, all four studies (33%) that we deemed transparent regarding educational content^{37,38,59,60} described MI techniques; three (25%) explicitly stated that educational content had been informed by theory^{37,38,59} (i.e., transtheoretical model of behavior change [TTM],⁶² health belief model [HBM],⁶³ and social cognitive theory [SCT]⁶⁴). All three of these studies included

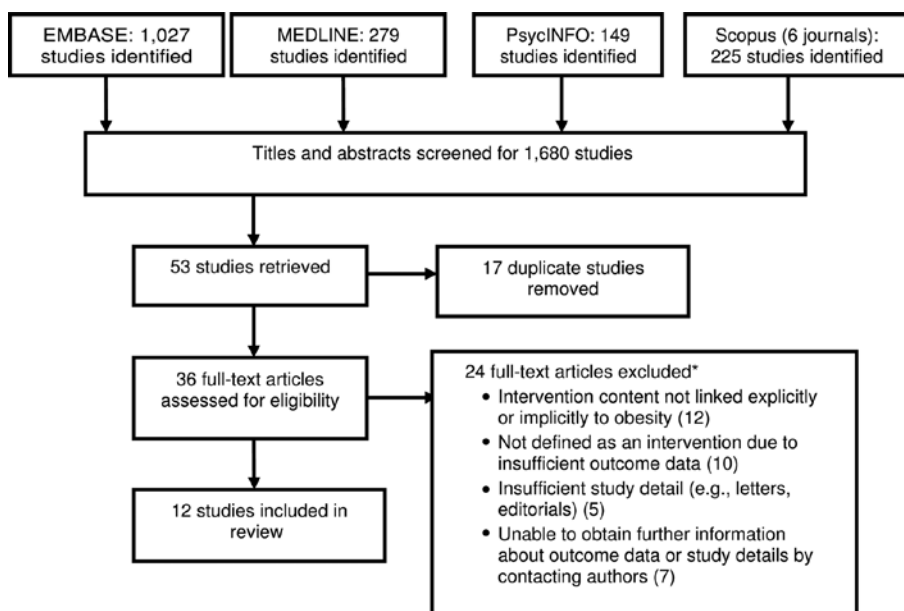


Figure 1 Flowchart of systematic review study selection procedures. *The total number of excluded studies is >24 because 10 studies were excluded for two reasons.

Table 2

Characteristics of 12 Studies on Obesity Management Educational Interventions for Medical Students Published Between 1993 and 2010*

Source	Country	Participants, group: no.	Year at medical school	% Female	Ethnicity (%)	Study design [†]
Barss et al, 2008 ⁵²	United Arab Emirates	Intervention: 50	1	63%	NR	Evaluation-only study
Bell and Cole, 2008 ³⁸	United States	Intervention: 53	3	NR	NR	Before-and-after study
Carson et al, 2002 ⁵³	United States	Intervention: 156	4	42%	NR	Controlled trial (nonrandomized)
		Control: 40	NR	37%	NR	
Conroy et al, 2004 ⁵⁴	United States	Intervention: 137	2	NR	White 54%	Controlled trial (nonrandomized)
		Control: 30	2	NR	NR	
Endevelt et al, 2006 ⁵⁵	Israel	Intervention: 122	2	37%	NR	Evaluation-only study
Hodgson, 2000 ⁵⁶	United States	Intervention: 130 [‡]	1, 3, 4	NR	NR	Controlled trial (nonrandomized)
		Control: NR	2	NR	NR	
Kashani et al, 1993 ⁵⁷	United States	Intervention: 207	1, 4	29% [§]	White 64.7%, black 6.8%, Asian 16.4%, Hispanic 9.2%, other 2.9% [§]	Controlled trial (nonrandomized)
		Control: NR	4	NR	NR	
Kolasa et al, 1999 ⁵⁸	United States	Intervention: 155	1, 3, 4	50%	NR	Before-and-after study
Moser and Stagnaro-Green, 2009 ³⁷	United States	Intervention: 150	3	NR	NR	Evaluation-only study
Poirier et al, 2004 ⁵⁹	United States	Intervention: 42	1	NR	NR	Before-and-after study
Rodríguez and Fornari, 2006 ⁶⁰	United States	Intervention: 18	3	NR	NR	Evaluation-only study
Schroder et al, 2010 ⁶¹	New Zealand	Intervention: 72	5	74%	NR	Qualitative study

* NR indicates that data were not reported within the article.

[†] *Evaluation-only study*: Measures were administered after implementation only, and there were no baseline measures and no control group; *before-and-after study*: measures were taken before and after intervention implementation, and there was no control group; *controlled trial (nonrandomized)*: measures were taken before and after intervention implementation, and a control group was included, but participants were not randomly assigned to groups; *qualitative study*: participant data were obtained following intervention implementation and analyzed using qualitative methods only, and there was no control group.

[‡] The pretest N value for the study was 130; the number of students in the sample receiving the intervention was not clear.

[§] Gender and ethnicity data for this study relate to the intervention group at year 1 of medical school, not at year 4, where demographics may have changed because of attrition (year 4, n = 94).

the TTM, whereas one study³⁷ also used the HBM and SCT to inform the intervention content.

Intervention outcomes and reported results

The 12 included studies targeted a wide range of outcomes, which are detailed in Appendix 2. Below, we summarize the reported results of interventions by study design. (The results of the qualitative study⁶¹ are summarized in Appendix 2.)

Controlled trials (n = 4; 33%). Although the four controlled trials^{53,54,56,57} evaluated various changes in students' knowledge, confidence, attitudes, and clinical skills as well as in their personal physiological

and psychosocial measures, few statistically significant between-group differences were identified. Evidence was particularly limited for student knowledge, confidence, and attitudes (reported, respectively, in one,⁵³ two,^{53,54} and no studies). Findings regarding performance measures were similarly limited: one study⁵³ reported that, after the intervention, students who received the intervention's education sessions were no more likely to engage in nutrition discussions with patients than were students in the control group ($P = .067$). Another study⁵⁷ reported limited improvements to students' diets as well as reduced physical activity levels after the intervention.

Before-and-after studies (n = 3; 25%). All three before-and-after studies^{38,58,59} reported significant postintervention knowledge improvements (of MI and/or the role of nutrition in cancer). Some also reported statistically significant improvements in confidence (counseling patients),^{38,59} attitudes (about physicians' roles),⁵⁸ and MI skills.³⁸ Students reported intentions to change their approach with future patients³⁸ and to spend more time counseling patients⁵⁸ after interventions. Students' perceptions of the educational interventions were generally positive, and two studies reported high levels of satisfaction.^{38,59}

Evaluation-only studies (n = 4; 33%). In the four evaluation-only studies,^{37,52,55,60} self-report measures of knowledge suggested increases in students' understanding about obesity and nutritional risk⁵⁵ and the biopsychosocial approach to patient care.³⁷ Students also reported improvements in their counseling skills,³⁷ general research skills,⁶⁰ and attitudes (being more open to the topic of behavior change).³⁷ Finally, students reported improvements in diet and activity patterns (theirs⁵² or their patients'⁶⁰). Despite these generally positive outcomes, students' evaluations of the educational interventions were mixed.^{55,60}

Risk of bias within studies

Coders' appraisals of study quality were in line with our three main criteria: intervention transparency, control for risk of bias, and conclusions supported by sufficient evidence.

Intervention transparency. Four studies (33%)^{37,38,55,59} included descriptions of educational content that we deemed sufficient to allow for replication. In contrast, nine studies (75%) provided methodological descriptions that we judged would allow for replication.^{37,52–55,57,59–61}

Control for risk of bias. Although seven studies (58%)^{38,53,54,56–59} made attempts to control for risk of bias, these efforts mainly involved baseline measures or control groups. (Only four studies [33%] included both baseline measures and control groups).^{53,54,56,57} None of the studies used randomization procedures or power calculations. Validation procedures for outcome measures were briefly described in five studies (42%),^{38,53,55–57} and participant response rates were below 50% for some outcome measures in four studies (33%).^{38,53,54,57}

Conclusions supported by sufficient evidence. We judged six studies (50%)^{37,38,53,54,59,61} to have sufficiently qualified conclusions with evidence in the article. In evaluating the other six studies,^{52,55–58,60} the coders noted that conclusions were not clearly described, that assumptions reached beyond the results, and that the lack of control within studies prevented the reporting of convincing evidence to support conclusions. In addition, only one study³⁸ calculated

the effect sizes of significant differences reported between participant groups.

Discussion

This systematic review of the literature identified just 12 studies published between 1990 and 2010 about educational interventions for medical students that addressed facilitating lifestyle changes with obese patients. Our analysis of these studies revealed numerous approaches to designing and implementing education in this area, with wide variations in terms of how curricula were structured and delivered (Appendix 1). None of the studies compared approaches, however, and thus the advantages or disadvantages of delivery within particular contexts or by certain individuals remain unclear. Our findings correspond to previous research indicating that education about specific health behaviors (e.g., smoking, physical activity) occurs infrequently within medical education^{65,66} and that general behavior change skills courses often lack consistency and structure in terms of their educational content.^{38,39} This, in addition to reports that frontline medical professionals feel unskilled in obesity management,^{13,40,41} suggests that calls from governing bodies encouraging integration of this topic into medical practice and education have not been met.^{29,34,39} Solving the problems related to integrating relevant content into medical curricula could be key to resolving this; such problems may include a lack of available subject experts, not assessing students' knowledge or skills in this area, or existing perceptions of the topic (e.g., considering it a low-profile subject).^{5,67}

One of our key findings from this review was the lack of theory reported to inform the content of studies' educational interventions. We found that reported educational interventions were mostly atheoretical (75% of the 12 studies), contradicting evidence that theory-based behavior change interventions are the most effective.^{16,31} The few studies in which interventions were theoretically informed used the TTM, which is acknowledged to have a limited evidence base and has received criticism regarding its key assumptions.^{68,69} Further, it has been well documented that the content of behavior change interventions is often not described adequately, making studies difficult to replicate, evaluate, or compare.⁷⁰ This issue clearly emerged

within our review: Descriptions of the specific behavior management techniques taught were rare and, when present, were mostly limited to MI (Appendix 1) even though numerous techniques exist in the behavior change literature.⁷¹ Past interventions to prevent weight gain in community-based contexts can also be criticized for failing to incorporate existing knowledge of behavioral determinants included within theoretical frameworks.⁷² Thus, our findings build on evidence suggesting that practical application of techniques is not developing at the same pace as theoretical advances in behavior change research.³² This issue must be addressed if education provided to medical students in this increasingly important area of medicine is to be considered truly evidence based.

Our findings also highlight concerns regarding the methodological rigor of studies in this review. Although a range of positive intervention outcomes were reported, measures to control for the risk of bias were rare. Just four studies (33%) included both baseline measures and control groups,^{53,54,56,57} and none calculated power or used randomization procedures. Therefore, the evidence provided was insufficient to determine whether the variability reported in outcome measures derived from intervention effects or from other unknown factors. The lack of robust evaluations within the literature we reviewed means that we cannot confidently draw conclusions regarding the efficacy of interventions or the contribution of this literature in informing education within this area.

Our findings should, however, be considered within the strengths and weaknesses of this review. To ensure a rigorous, replicable review of the literature relevant to the study question, we designed a search strategy in line with standardized PICOS criteria.⁴⁴ To reduce risk of bias, we assessed interrater reliability using an independent second coder at study selection. Search criteria were limited to English-language articles and published research, which may have led us to overlook other relevant research. Further, because we did not use existing data extraction tools, it is possible that we developed our tools in line with subjective judgments about what information would be most appropriate to extract. The methodological diversity

of included studies made it more appropriate to select only the most relevant components from certain existing tools,^{44,48–50} thereby excluding many redundant items. Finally, because of our tailoring of data extraction tools to the needs of this review, potentially subjective coder judgments rather than objective criteria informed quality appraisals. Research team members conducted validity checks throughout data synthesis, and coders reached consensus at all stages, which suggests that possible coder bias was prevented.

Despite some limitations, our findings indicate that more work is needed to develop and identify evidence-based educational interventions about obesity-related lifestyle changes. Future research should ensure that intervention content is transparent and that methodological rigor is applied to study designs. Future interventions should specifically apply relevant theories and known behavior change techniques. Additionally, research outside the United States is needed because few medical schools from other countries were represented in this review. We conclude that current educational interventions for medical students that address obesity management are varied, and empirical tests of their efficacy are inadequate. It therefore remains unknown to what extent medical students are being prepared to facilitate important lifestyle changes with future obese patients or what the best methods to achieve this involve.

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Appendix 1

Intervention Content, Structure, and Delivery Procedures of Obesity Management Education Interventions for Medical Students in 12 Studies Identified in a Systematic Review of the Literature*

Source	Intervention content			Intervention structure and delivery		
	Health topics addressed	Explicitly informed by behavior change theory	Techniques included to facilitate patient behavior change	Health professionals involved in delivery	Educational methods and session durations	Estimated student contact time [†]
Barss et al, 2008 ⁵²	Child obesity, weight loss (in nursing home patients), nutrition/diet, exercise, smoking, home and car safety, yoga of praying, cancer, CVD, osteoporosis, hypertension, food-borne diseases	NR	NR	Faculty from community medicine and medical education departments	5 lectures; students conducted home interview (family's lifestyle history and observation of lifestyle behaviors); students assessed own lifestyle (1-week activity log, computer-based assessment, manual BMI measurement); student oral presentations (to peers and faculty)	NR
Bell and Cole, 2008 ³⁸	Weight loss, smoking, alcohol, medication adherence	Stages of change	MI techniques: assess readiness to change (interest, confidence, readiness on a scale of 1–10), mutual agenda setting, decisional balance, individualized feedback, ask “where do we go from here?” negotiate change plan; OARS	A primary care physician, a social worker, a graduate student educator	Four 2-hour sessions across 4 weeks, including didactics (MI principles/practice), role-play, video demonstrations and recordings of student–patient interactions, peer review, group discussion/brainstorms, trainer observation and feedback; pre- and postcourse assessments	8 hours
Carson, et al, 2002 ⁵³	Obesity, nutrition/diet, alcohol, CVD, hypertension, hypercholesterolemia, hyperlipidemia, diabetes	NR	NR	A physician and a dietician	Compulsory lectures (twice weekly for 4 weeks); participation in various clinics (6 half-days [estimated at 4 hours each] per week, for 4 weeks); 2 Web-based patient cases (averaging 2.3 hours to complete); resource materials and pocket reference cards provided; role modeling (physician/dietician input into computerized patient cases); 1-hour class discussion—students created management plans for patient cases and received feedback on them	99.3 hours
Conroy et al, 2004 ⁵⁴	Obesity, nutrition/diet, exercise, screening, immunization	NR	NR	A dietician	14 weekly sessions including 45-minute lectures and 90-minute PBL tutorials; simulated cases to teach counseling skills; student-led debates; final exam; self-assessment of students' health behaviors via food-frequency questionnaire (with feedback on results); completed and analyzed personal diet record (reviewed with a dietician)	31.5 hours
Endevelt et al, 2006 ⁵⁵	Obesity, overweight, nutrition, diabetes	NR	NR	NR	Workshop involving 4 lectures (and associated reading); practice interviewing and assessing patients about nutrition; PBL case; presentation defending 1 type of obesity treatment; class discussion	10 hours
Hodgson, 2000 ⁵⁶	Nutrition/diet	NR	NR	NR	10 lectures; 2 PBL cases; laboratory exercises to practice nutrition skills; dietary self-assessment; standardized patient interviews	NR
Kashani et al, 1993 ⁵⁷	Nutrition/diet, physical activity, smoking, CVD, diabetes, depression	NR	NR	Senior medical students, physical education and nutrition students, preventive medicine residents, trained pulmonary function technicians, faculty physicians, dieticians, psychologists	Didactic sessions; extensive feedback to students with “at-risk” behavioral/physiological assessment findings; clinical setting experiences (clinical practice exposure, working with preventive cardiology faculty)	NR

(Appendix continues)

Appendix 1 (Continued)

Source	Intervention content			Intervention structure and delivery		
	Health topics addressed	Explicitly informed by behavior change theory	Techniques included to facilitate patient behavior change	Health professionals involved in delivery	Educational methods and session durations	Estimated student contact time [‡]
Kolasa et al, 1999 ⁵⁸	Maintaining healthy weight, nutrition/diet, alcohol, cancer	NR	NR	NR	Computer-based (CD-ROM) patient case simulations of a breast cancer case (median completion time = 60 minutes) and a lung and a colon cancer case (median completion time = 90 minutes each). Included information on risk factors for cancer, short modules, animations, video interviews with experts, video clip demonstrating nutrition counseling, graphics, dialogue with computer about students' knowledge of cancer risk factors (i.e., free-form answers with new/correct information fed back to students). Students' performance saved by computer and reviewed by an instructor	1–1.5 hours [†]
Moser and Stagnaro-Green, 2009 ³⁷	Obesity, smoking, exercise, nutrition/diet, yoga, medication adherence, medically unexplained symptoms	Health belief model, social cognitive theory, stages of change	MI techniques: decisional balance, assess/activate readiness to change through targeting theoretical constructs (e.g., perceived susceptibility/severity); construction of biopsychosocial care plans	NR	4-week course (15-hour curriculum; 5 half-day ambulatory sessions in internal medicine), including interactive lectures, MI workshops (skills practice), standardized patient (SP) interviews, group interviews, video assessment of SP interviews (VASE-R), role-plays, stages-of-change video, discussion, community group project, individual wellness plans by and for students, observation of stages-of-change model used (smoking cessation community program), reflective journals, completion of decisional balance sheets and smoking cessation forms, formative feedback via learning quizzes, and exams	60 hours
Poirier et al, 2004 ⁵⁹	Obesity, smoking, medication compliance, sedentary lifestyle, alcohol, exercise	Stages of change	MI techniques: reflective listening, decisional balance, assess readiness to change; FRAMES; OARES	General internist, psychiatrist/psychologist (with special interest in behavior change), nicotine dependence counselors	Five 2-hour sessions including didactic presentations, small-group exercises, role-play (observation and performance feedback), counseling skill practice (reflective listening with vignettes), reading material on MI interventions and assessing patients' readiness to change, interview skills checklist (with immediate feedback), discussion, demonstrative video clip (students then offered other examples of reflective listening statements), practice developing statements to diffuse patient resistance, sandwich feedback (positive, negative, positive comments)	10 hours
Rodriguez and Fornari, 2006 ⁶⁰	Obesity, nutrition/diet, exercise	NR	Stress management (no further detail)	NR	Practical implementation of lifestyle modification interventions designed by students, 2 days weekly for 4 weeks. In pairs, students visited obesity groups to give patients tools to change their behaviors (8–12 hours per week, 4 weeks)	32–48 hours
Schroder et al, 2010 ⁶¹	Overeating, diet	NR	NR	Representatives from an OA group	Students attended and observed an OA meeting in the community and submitted a reflective report of their experiences	NR

* CVD indicates cardiovascular disease; FRAMES, Feedback, Responsibility, Advice, Menu, Empathy, Self-efficacy; MI, motivational interviewing; NR, not reported within article; OA, Overeaters Anonymous; OARES, Open-ended questions, Affirmations, Reflective listening, Elicit self-motivational statements, Summarize; OARS, Open-ended questions, Affirmations, Reflections, Summarize; PBL, problem-based learning.

[†] One student spent four hours on the program.

[‡] Estimated contact time relates to duration of the entire intervention (not exclusively the time involving obesity-management education).

Appendix 2

Details of Reported Outcomes for Educational Interventions on Obesity Management for Medical Students in 12 Studies Identified in a Systematic Review of the Literature*

Source	Specified learning/intervention outcomes (data collection tools)	Respondents, no. (% of total sample [†])	Statistical analysis of intervention outcomes	Main findings reported
Barss et al, 2008 ⁵²	<ul style="list-style-type: none"> Counseling knowledge and skills; change in students' health behavior Attitudes on importance of community medicine/population health (self-report questionnaire) 	27 women, 16 men (86%)	%, McNemar test, 95% CIs, <i>P</i> values	<ul style="list-style-type: none"> Increased awareness of health behaviors/counseling knowledge (53%/42% strongly agreed), improved observational skills (53% agreed) 35%–74% reported unspecified level of change across 10 separate behaviors relating to their diet/exercise ($P < .0004$ for 6 of these 10 behaviors) 7%–74% reported unspecified changes to 5 other health behaviors (relating to smoking, car safety, and food hygiene)
Bell and Cole, 2008 ³⁸	<ul style="list-style-type: none"> MI knowledge, confidence, skills (quiz, self-report, objective assessment) Intervention evaluation (scaled questionnaire) Student intentions to modify patient consultations (commitment to change [CTC] statements; followed up via online survey) 	<ul style="list-style-type: none"> Knowledge/confidence/skills: 50 (94%) Evaluation: 53 (100%) CTC survey: 24 (45%) 	<ul style="list-style-type: none"> Knowledge/confidence/skills/evaluation: paired <i>t</i> tests, mean, %, <i>P</i> values, Cohen <i>d</i> (skills only) CTC: % implemented 	<ul style="list-style-type: none"> Increased knowledge, confidence assessing/counseling patients (all $P < .001$) Total MI skills increased ($d = 1.54$, $P < .001$) Intervention rated as positive (94%), valuable (91%), and satisfaction increased ($P < .001$) 81% of CTC statements were reported as partially/fully implemented; barriers included lack of opportunity/time
Carson et al, 2002 ⁵³	<ul style="list-style-type: none"> Knowledge of cardiovascular nutrition, self-efficacy in identifying/advising patients, attitudes on importance of addressing cardiovascular nutrition/dietary change (objective questionnaire) Skills–frequency of consultations addressing nutrition (audited chart notes) 	<ul style="list-style-type: none"> Questionnaire: intervention, 156; control, 40 (100%) Audit: intervention, 51 (33%); control, 22 (55%) 	<ul style="list-style-type: none"> Questionnaire: paired <i>t</i> test, means, SD, 2 × 2 repeated-measures ANOVA, <i>P</i> values % Audit data Correlations, R^2 	<ul style="list-style-type: none"> Increased knowledge (intervention group only; $P < .001$); self-efficacy (group-by-time effect $P < .001$); attitudes (equal for both groups, group by time effect $P = .983$) Independent predictors of self-efficacy were knowledge and attitudes (reported post intervention) and self-efficacy (reported pre intervention) 252 chart notes reviewed: nutrition addressed in 36% of intervention group and 25% of control group consultations ($P = .067$)
Conroy et al, 2004 ⁵⁴	Student health behavior change including diet/exercise patterns, confidence assessing and facilitating behavior change with patients (self-report survey)	For baseline/follow-up: <ul style="list-style-type: none"> Intervention: 134/118 (98%/86%) Control: 23/13 (77%/43%) 	Survey means, standard error, McNemar test, paired <i>t</i> tests, <i>P</i> values	<ul style="list-style-type: none"> Improved confidence ($P < .001$) and diet/exercise patterns (72%/18% of intervention group) No significant differences for control group
Endevelt et al, 2006 ⁵⁵	<ul style="list-style-type: none"> Nutrition/obesity knowledge (MCQs) Student evaluations of importance/relevance, quality of teaching (scaled questionnaire) 	Both measures: 122 (100%)	<ul style="list-style-type: none"> MCQs: % correct Questionnaire: means, SD 	<ul style="list-style-type: none"> MCQs: correct answer range across both cohorts = 61%–100% Intervention evaluations: overall ratings range = 3.4–5.7 (out of 7)
Hodgson, 2000 ⁵⁶	Nutrition knowledge (objective progress survey, assessing confidence)	<ul style="list-style-type: none"> Pretest (intervention): 130 (88%) Posttest time points, intervention: 136 (93%), 89 (72%), 53 (70%), 20 (83%); control: NR 	<ul style="list-style-type: none"> Confidence scored by "don't know" response frequency: +1 = correct, -1 = incorrect, 0 = don't know Survey means, SD Repeated-measures ANOVA: <i>f</i> (<i>df</i>), <i>P</i> values 	<ul style="list-style-type: none"> Overall knowledge increase, $f = 23.3$ (4, 16), $P < .001$ Pre–post intervention: correct answers increased $f = 61.89$ (3, 21), $P < .001$; "don't know" answers decreased, $f = 64.69$ (3, 21), $P < .001$; incorrect answers increased, $f = 3.70$ (3, 21), $P < .05$ No knowledge differences between control and intervention groups (details reported elsewhere)

(Appendix 2 continues)

Appendix 2 (Continued)

Source	Specified learning/ intervention outcomes (data collection tools)	Respondents, no. (% of total sample [†])	Statistical analysis of intervention outcomes	Main findings reported
Kashani et al, 1993 ⁵⁷	<ul style="list-style-type: none"> Preventive cardiology attitudes; cardiovascular risk factor knowledge (self-report questionnaire) Student health (various psychosocial, behavioral, physiological measures) 	94 (45%) in intervention group completed all intervention measures; control group, NR	Paired- and independent-sample <i>t</i> tests (means, SD, <i>P</i> values)	<ul style="list-style-type: none"> No significant differences found between knowledge/attitudes of the intervention and control groups (<i>P</i> = .05) Fat consumption reduced among men only (difference between gender groups, <i>P</i> < .001) Physical activity frequency reduced among intervention group men and women (<i>P</i> < .05)
Kolasa et al, 1999 ⁵⁸	<ul style="list-style-type: none"> Knowledge (objective questionnaire) Attitudes toward intervention content, about role of physician in nutrition counseling, ease in using program (scaled/open questionnaire) Intention to use learned counseling skills (self-report questionnaire) General impression of intervention (talk-aloud method: students videotaped describing their thoughts as they used the computer program [CD-ROM]) 	147 (95%) completed all intervention measures	<ul style="list-style-type: none"> Knowledge: % correct answers Attitudes: %, chi-square test, <i>P</i> values 	<ul style="list-style-type: none"> Increased knowledge about 4 of 7 assessed dietary principles related to cancer (<i>P</i> < .001) Increased beliefs that nutrition has an important role in cancer risk and physicians have a role in counseling (<i>P</i> < .001) 93% intended to alter their approach to patient/personal health behaviors, 62.6% would increase time spent counseling, and 25% would plan more nutrition discussions with patients 22% felt program was time consuming; "almost all" agreed that students would complete it only if it was compulsory
Moser and Stagnaro-Green, 2009 ³⁷	<ul style="list-style-type: none"> Knowledge of health models, attitudes toward behavior change, behavior change counseling skills (self-report questionnaire) Intervention evaluation (informal student/faculty feedback) 	Questionnaire: 149 (99%)	Questionnaire means, SD: outcomes assessed by 5-point Likert scale (e.g., the course enhanced my knowledge 1 = not at all; 5 = to a high degree)	<ul style="list-style-type: none"> Perceived knowledge increases (means ranged from 3.9 to 4.5 on 9 knowledge items), skills development (mean = 4.2, SD = 0.8 on 1 skills item), attitude change (mean = 4.2, SD = 0.9 on 1 attitude item)
Poirier et al, 2004 ⁵⁹	<ul style="list-style-type: none"> Confidence in behavior change communication skills (self-report questionnaire) MI knowledge (MCQs) Intervention evaluation of (helpfulness of teaching/course materials) (scaled questionnaire) 	<ul style="list-style-type: none"> Questionnaire and MCQs baseline/follow-up: 42 (100%) / 36 (86%) Evaluation, 35 (83%) 	<ul style="list-style-type: none"> Confidence: % responses, 2-tailed <i>P</i> values from signed rank test MI knowledge: % correct MCQs, 2-tailed <i>P</i> value from sign test of discordant responses 	<ul style="list-style-type: none"> Confidence increased pre to post intervention (all items <i>P</i> < .001 on signed rank test) Knowledge increased in 2 of 4 MCQs (<i>P</i> < .05); overall knowledge increased (<i>P</i> < .005) Intervention evaluation: students rated role-play and faculty interaction as most helpful
Rodríguez and Fornari, 2006 ⁶⁰	<ul style="list-style-type: none"> Research skills development: collecting data/interpreting results (self-report scale) Intervention evaluation (student survey) Patient health behavior change (self-report questionnaire) 	NR	Survey response averages and %	<ul style="list-style-type: none"> Improved research skills reported (average rating ≥ 2.5 for all 6 items, on scale where 1 = not at all, 2 = somewhat, 3 = substantially improved) All students reported the intervention met/exceeded expectations and would recommend it to peers Patients reported healthier eating/activity patterns (62%) and decreased waist circumference (46%)
Schroder et al, 2010 ⁶¹	Understanding about the concept and experiences of those suffering from addictive overeating (assessed through thematic analysis of student reflective reports)	72 (100%)	Narrative description of thematic analysis	<p>3 emergent themes:</p> <ul style="list-style-type: none"> Concept of addictive overeating was novel to students Students discovered food caused disruption to sufferers' lives and highlighted emotional and social consequences of addictive overeating OA visit as a learning tool: students felt able to advise patients (referral) and were more comfortable talking with patients about food

*ANOVA indicates analysis of variance; CI, confidence interval; *df*, degrees of freedom; *f*, frequency; MCQ, multiple-choice question; MI, motivational interviewing; NR, not reported within article; OA, Overeaters Anonymous; SD, standard deviation; SE, standard error; VASE-R, video assessment of simulated encounters—revised.

[†] Total participant group sizes are reported in Appendix 1.