DESIGN, IMPLEMENTATION, AND EVALUATION OF

A COLLABORATIVE ONLINE CASE-BASED LEARNING CURRICULUM ABOUT

OBESITY PREVENTION AND TREATMENT

by

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(Under the Direction of Joan G. Fischer, PhD, RDN, LD)

ABSTRACT

Obesity continues to be a major public health issue within the United States, as approximately 35% of adults and 17% of children and adolescents were considered obese in 2011-2012. Health care providers are uniquely positioned to address obesity through client encounters, but many do not feel confident in their skills to counsel patients. Dietitians can be effective members of the weight management team because of their skills in utilizing the Nutrition Care Process to assess multiple factors, prioritize nutrition diagnoses, implement appropriate interventions, and monitor and evaluate outcomes. Therefore, it is important for undergraduate nutrition programs to provide a comprehensive overview of obesity prevention and treatment in their curriculum. However, many programs face time and budget constraints to provide additional material within the current curriculum. A possible solution is online case-based learning that facilitates learning through realistic cases. The purpose of this study was to design and implement four online collaborative case-based learning modules about obesity prevention and treatment and determine changes in student knowledge about obesity management and satisfaction with educational strategy after participating in an online facilitated,

scaffolded, asynchronous, collaborative case-based learning (CBL) module. There was a significant change in knowledge for students participating in the online module in a general life cycle nutrition class (10.2%, $p < 0.001$) and in the medical nutrition therapy I class, which was compared to a paper-based case study group (6.5% vs. -0.6%, $p = 0.05$). Participants in all modules expressed satisfaction with the content of the modules if not the logistical issues of utilizing the learning management system. Overall, online collaborative case-based learning was at least as effective as paper-based case studies for teaching students about obesity prevention and treatment, and students were satisfied with their learning experience.

INDEX WORDS: dietetics education, obesity, obesity prevention, obesity treatment, case-based learning, online education, collaborative education, undergraduate education

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DEDICATION

This work is dedicated to my family, who in multiple ways, pushed me towards this path that I never dreamed possible. Thank you for making me reach higher. This work is also dedicated to Clara, Andrew, Tegan, and Buddy, who tolerated my piles of paper and late nights over the last eight years.

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CHAPTER 1

INTRODUCTION

Obesity continues to be a major public health issue in the United States, as approximately 35% of adults and 17% of children and adolescents were considered obese in 2011-2012.[1] Because of the associated health risks, medical costs, and potential economic impact of obesity, the United States Department of Health and Human Services in their *Healthy People 2020* established a goal to decrease the percentage of Americans who are obese to less than 30.5% of the population, which is a 10% reduction from baseline data.[2] Because the causes of obesity are multifactorial and multi-level in nature,[3] everyone – healthcare providers, teachers, parents, policy makers, business leaders, and community advocates – must be involved in prevention efforts. A key target audience to effect change includes undergraduate university students who will become the next generation of healthcare providers, teachers, parents, and professional and political leaders. Therefore, it is important for an undergraduate nutrition curriculum to include a comprehensive overview of obesity prevention and treatment, giving future leaders a working knowledge of the health risks and consequences associated with obesity, its contributing factors, and potential targets for intervention through evidence-based practice.

Four-year colleges and major research universities face multiple resource constraints in providing additional material within their current curricula. One solution is using online methods to deliver additional information to students within current classes. Online learning must be designed to ensure development of critical thinking skills to be effective. An additional consideration is the need to provide experiential learning for students. The Academy of Nutrition

and Dietetics Council on Future Practice emphasized in their *Visioning Report* the need for undergraduate didactic programs to include a practicum or other experiential learning opportunity to foster development of critical thinking, leadership, communication, and management skills, allowing students to translate theory to actual practice.[4] Didactic programs must be creative in provision of such experiential learning due to time constraints, as well as limited number of practicum preceptors in many regions of the United States. Simulations offer a possible solution by allowing students to practice skills learned in class in a setting similar to what would be encountered in the workforce without the need for additional preceptors.[4] Case-based learning is one simulation method that allows students to practice skills and actively solve problems in a setting they are likely to encounter in their future work.[5] Case-based learning is situated on a continuum between teacher-led lecture-based instruction and student-led problem-based learning.[6,7] Unlike problem-based learning, the instructor in case-based learning establishes learning objectives[7] for the case study and guides students through the inquiry process ("scaffolded learning")[8] by providing resources and asking guiding questions. Case-based learning that simulates real-world experiences facilitates learning of knowledge and skills[9]; however, only a limited number of studies have evaluated the effectiveness of case-based learning in nutrition courses.

The purpose of this study was to develop and pilot-test a series of online collaborative case-based learning modules about obesity prevention and treatment to determine the effectiveness and acceptance of this innovative methodology. The research question was "How does an online case-based learning module impact students' knowledge and skills related to obesity prevention and treatment?" The overall hypothesis was that case-based learning that incorporated collaborative learning and active reflection would increase students' knowledge and

skills associated with obesity treatment and prevention. The overall hypothesis was tested in students enrolled in senior level nutrition courses at the University of Georgia. The specific aims were:

Specific Aim 1. Determine current knowledge and attitudes towards obesity of students in introductory and senior level courses in nutrition. *It was hypothesized that* s*tudents who were dietetics or nutrition science majors would score higher on an obesity knowledge scale and have less negative outcomes expectancies towards obesity than non-major students and that students in a senior level practice-oriented nutrition class would score higher on an obesity knowledge scale and have less negative outcomes expectancies towards obesity than students in an introductory course in nutrition*

Specific Aim 2. Determine changes in knowledge and skills about obesity prevention and treatment related to participation in an online case-based learning module in senior-level nutrition courses. *It was hypothesized that students' knowledge and skills related to obesity prevention and treatment would increase as a result of participating in an online case-based learning module.*

Specific Aim. 3. Assess student perceptions of participating in an online collaborative case-based learning module. *It was hypothesized that students would value the online case-based learning modules as an opportunity to participate in a series of simulated patient encounters that incorporated a multidisciplinary approach.*

The subsequent chapters of this document describe the development, design, implementation, and evaluation of four online collaborative case-based learning modules in senior-level nutrition classes. Chapter 2 provides a review of the literature concerning the impact of obesity, the need for obesity education, online learning, case-based learning, and the design

for this mixed methods study. Chapter 3 is a manuscript to be submitted to the *Journal of Nutrition Education and Behavior* exploring differences in knowledge about obesity-related health risks between students in an introductory nutrition course and senior-level dietetics course. Chapter 4 is a manuscript to be submitted to the *Journal of Nutrition Education and Behavior* discussing the development, implementation, and evaluation of an online case-based learning module about pediatric obesity management in a life cycle nutrition class designed for students from multiple majors. Chapter 5 is a manuscript to be submitted to the *Journal of Nutrition Education and Behavior* discussing the design, implementation, and evaluation of an online case-based learning module about school wellness policies in a class focused on nutrition-related public health issues. Chapter 6 is a manuscript chapter to be submitted the *Journal of the Academy of Nutrition and Dietetics* about the design, implementation, and evaluation of two online case-based learning modules about using the nutrition care process,[10] a systematic process of assessing and diagnosing nutrition-related problems to develop and implement appropriate interventions, monitor indicators, and evaluate outcomes, and nutrition counseling in obesity management. Finally, Chapter 7 provides a summary of findings from these studies, as well as directions for future research.

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CHAPTER 2

REVIEW OF LITERATURE

Impact of obesity on society

Obesity continues to be a public health issue within the United States. A recent analysis of data from the National Health and Nutrition Examination Survey (NHANES) showed that approximately 35% of American adults aged 20 years or older were considered obese (BMI ≥30), 17% of children and adolescents (ages 2-19 years) were classified as obese (BMI ≥95th percentile of CDC 2000 growth charts), and over 8% of infants and toddlers from birth to 2 years of age had a high weight for recumbent length (≥95th percentile) in 2011-2012.[1] Obesity tends to disproportionately affect minority racial and ethnic groups. A greater percentage of non-Hispanic black and Hispanic children and adolescents were obese compared to their non-Hispanic white counterparts across age groups. For example, 11.3% of non-Hispanic black and 16.7% of Hispanic pre-school children (ages 2-5 years) were obese compared to 3.5% of non-Hispanic white children. During adolescence (ages 12-19 years), 22.1% of non-Hispanic black and 22.6% of Hispanic youth were obese compared to 19.6% of non-Hispanic white youth. This discrepancy is also seen in adulthood, as 47.8% of non-Hispanic black and 42.5% of Hispanic adults were obese compared to 32.6% of their non-Hispanic white counterparts when adjusted for age.[1] The importance of this finding is that these groups with a higher prevalence of obesity are also those who will be more likely to be burdened by the associated direct and indirect costs.[2]

One of the reasons for concern about the prevalence of obesity is its association with several chronic diseases, including but not limited to increased risk for cardiovascular disease,

stroke, type 2 diabetes, certain cancers (i.e., colorectal, endometrial, and breast), liver disease, gallbladder disease, sleep apnea, osteoarthritis, and infertility.[3] The increased risk for these chronic conditions contributes to rising healthcare costs associated with obesity, which Wang and colleagues[4] estimated will reach more than $860 billion by 2030 if current trends continue. In addition to increased medical costs, the economic impact of rising rates of obesity may result in lost productivity.[5] Productivity costs include losses related to increased absenteeism of workers who are obese, decreased productivity while at work likely secondary to obesity-related comorbidities, increased disability payments, decreased life expectancy, and reduced quality of life.[5]

Need for obesity education

Because of the associated health risks, medical costs, and potential economic impact of obesity, the United States Department of Health and Human Services in their *Healthy People 2020* established a goal to decrease the percentage of Americans who are obese to less than 30.5% of the population, which is a 10% reduction from baseline data.[6] There are multiple factors (i.e., genetics, behavioral, family and cultural norms, environmental, etc.) and multiple levels (i.e., individual, family, community, policy) that influence development of obesity.[7] Therefore, in order to achieve the 2020 *Healthy People* objective of reducing prevalence of obesity, everyone – healthcare providers, teachers, parents, policy makers, business leaders, and community advocates – must be involved in prevention efforts. Healthcare providers, in particular, are uniquely positioned to address obesity through client encounters; however, many lack self-efficacy to effectively counsel clients.[8] A key target audience to effect change includes undergraduate university students who will become the next generation of healthcare providers, teachers, parents, and professional and political leaders. Therefore, it is important for an

undergraduate nutrition curriculum to include a comprehensive overview of obesity prevention and treatment, giving future leaders a working knowledge of the health risks and consequences associated with obesity, its contributing factors, and potential targets for intervention through evidence-based practice.

Four-year colleges and major research universities face multiple resource constraints in providing additional material within their current curricula. One solution is using online methods to deliver additional information to students within current classes. Indeed, many universities, including The University of Georgia, are moving towards offering more classes and even degree programs online in an effort to reach more potential students.[9] Online learning must be designed to ensure development of critical thinking skills to be effective. Some studies have shown that online asynchronous learning networks may lead to greater collaboration and higher-level cognitive processes (i.e., analysis and integration) compared to face-to-face learning environments.[10]

An additional consideration is the need to provide experiential learning for students, as several universities are requiring service learning, research, or other hands-on experiences as a graduation requirement.[11] The Academy of Nutrition and Dietetics Council on Future Practice emphasized in their Visioning Report the need for undergraduate didactic programs to include a practicum or other experiential learning opportunity to foster development of critical thinking, leadership, communication, and management skills, allowing students to translate theory to actual practice.[12] Didactic programs must be creative in provision of such experiential learning due to time constraints, as well as limited number of practicum preceptors in many regions of the United States. Simulations offer a possible solution by allowing students to practice skills learned in class in a setting similar to what would be encountered in the workforce without the

need for additional preceptors.[12] Case-based learning that simulates real-world experiences facilitates learning of knowledge and skills[13]; however, only a limited number of studies have evaluated the effectiveness of case-based learning in nutrition courses.

The purpose of this study was to develop and pilot-test a series of online collaborative case-based learning modules about obesity prevention and treatment to determine the effectiveness and acceptance of this innovative methodology. The remainder of this literature review will discuss the need for additional coverage of obesity management in healthcare professional education, the unique role of registered dietitian nutritionists in obesity management and implications for training, a brief introduction to issues related to online learning, and an overview of case-based learning. This chapter concludes with the rationale for the study, research question, specific aims and hypotheses, an overview of the development of the online collaborative case-based learning modules, and introduction to the mixed-method study design and statement of subjectivity.

Education of healthcare professionals in obesity management

Physicians and other healthcare providers are uniquely positioned to address weight management through patient encounters. Unfortunately, some studies indicate that only 39% to 65% of obese patients are advised to lose weight by their healthcare providers.[14,15] Physicians most often provide weight loss advice to patients who are obese with comorbidities, such as type 2 diabetes or cholesterol.[15] Physicians usually discuss the health benefits of weight loss, dietary changes, and increasing physical activity to control weight.[14,16] However, few discuss behavioral strategies for weight loss.[15] Advice given by physicians can have a positive effect on patients' weight management, as patients receiving such advice may be more likely to decrease intake of both fat and calories and increase physical activity to lose weight.[17] Therefore, it is important for

physicians and other healthcare providers to feel confident in their skills to address obesity in practice.

However, many physicians may not feel prepared to provide weight management counseling for their patients. A systematic review by van Gerwen et al[8] showed that few studies reported physicians' childhood obesity-related knowledge. Physicians reported relying on professional guidelines as sources of information about obesity prevention and treatment (92%). In two studies, however, less than 25% of physicians were familiar with international guidelines, such as the World Health Organization Expert Committee or American Academy of Family Physicians recommendations, with 10% of these physicians considering the guidelines "impractical." The minority of physicians believed that they were competent in treating childhood obesity; however, doctors who had received additional training felt more confident in their abilities.[8] Therefore, education about obesity prevention and treatment should be included in either undergraduate or medical education curricula.

Indeed, pre-professional health students indicated a desire for more information about obesity in a study by Swift et al.[18] A total of 38 dietetics, 162 nursing, and 389 medical students completed the Obesity-Risk Knowledge scale (ORK-10), a 10-question validated survey measuring knowledge about health risks associated with obesity. The ORK-10 is designed to be self-administered and examines knowledge about obesity-related health risks, such as increased risk for hypertension, post-menopausal breast cancer, and colorectal cancer, and recommendations for weight loss.[19] The format of the questions is "True/False/Don't know." The survey was designed for populations in the United Kingdom. Correct items are given one point. A higher score on the ORK-10 is associated with greater knowledge of obesity-related health risks.[19] Results showed that knowledge increased over the four-year course of study, with

dietetics students scoring significantly higher than other trainees in their last year of study. Almost half of nursing and medical students believed that they should have received more training related to consequences of obesity.[18] Similarly, a study of Saudi Arabian dental students showed that 37% of respondents reported inadequate (fair/poor) knowledge of pediatric overweight and obesity while about half of the respondents reported average knowledge of adult obesity.[20] Over three-fourths of respondents believed that dentists should play a role in assessment and prevention of pediatric obesity, which indicates a need for additional education in obesity management across healthcare professions.[20]

A thorough understanding of the causes and consequences of obesity may facilitate discussions between healthcare providers and patients, especially as many patients may hold different opinions about the causes of and solutions to obesity. For example, a study by Ogden and Flanagan[21] showed that compared to general practitioners, a greater percentage of lay people attributed obesity to biological causes (ie, genetics, hormones, or slow metabolism) (46.3% vs. 28.8%). Fewer lay people considered behavioral (ie, eating too much or not being physically active) (79.2% vs. 97.3%), structural (ie, fast food culture, high price of healthy foods) (44.3% vs. 58.9%), and social (ie, low income, unemployment, lack of education) (32.2% vs. 45.2%) factors as causes of obesity. A greater percentage of lay people viewed weight loss surgery (47.9% vs. 39.7%) and counseling (48.5% vs. 38.4%) as solutions to obesity compared to physicians.[21] It is important for healthcare providers to understand how their clients think about obesity in order to effectively address the issue in practice. Durant et al[22] showed that while overweight and obese non-Hispanic black and Hispanic patients were half as likely to believe that their weight was detrimental to their health as their non-Hispanic white counterparts, they were more almost nine (9) times as likely to perceive this risk if they were advised by a

healthcare provider compared to those who had not discussed weight with their provider. Hispanic patients were over 36 times more likely to believe that their weight was damaging to their health if a provider told them that they were overweight or obese.[22]

Because patients are often responsive to their physicians and other health care providers, it is important for these providers to not only be knowledgeable about obesity and its impact on health but also recognize their attitudes towards obesity to ensure the best care. A 2011 systematic review by Budd et al[23] examined health care professionals' attitudes about obesity. A total of 15 studies from a variety of health care professions was included in the analysis. The researchers concluded that overall attitudes towards obesity among healthcare professionals continued to be negative; however, their attitudes did not seem to impact care. On the other hand, a recent study by Huizinga et al[24] showed that physicians were less likely to believe that obese patients adhered to their medication regimen, which may affect prescription practices by these physicians. Similarly, Bleich et al[25] found that physicians' beliefs about cause of obesity impacted the behaviors on which they focused in counseling patients. Bachelor's level nursing students in the United Kingdom[26] believed that obesity was less under a person's control compared to their dietetics, medicine, and Master's of Nursing counterparts, which may impact patient care.[25] Levels of fat phobia as measured by the Fat Phobia Scale were significant among all groups of trainee students. Although fat phobia tended to decrease over the course of study, the authors concluded that more training in the curricula was needed to adequately change negative attitudes about obesity.[26] Interestingly, a study by Poon and Tarrant[27] showed that registered nurses had higher levels of fat phobia and a more negative attitude towards obese patients than student nurses and believed that these patients should be on a weight loss diet while in the hospital. Among U. S. dietetic students, a moderate amount of weight-based bias and

belief that obese patients are less likely to comply with treatment may also exist.[28,29] For example, Berryman et al found moderate levels of "fat phobia" in a group of dietetics students, but they were comparable to their non-dietetic peers.[29] The authors concluded that the dietetics curriculum did not foster weight-based bias, but society as a whole promoted weight-based bias. Attitudes and beliefs by health care professionals may impact assumptions made about obese patients' needs. As mentioned above, patients may have different beliefs about causes of obesity,[21] so healthcare providers should recognize their own biases and adapt the focus of their counseling strategies to their patients needs. Therefore, additional training is needed to facilitate a holistic approach to patient care.

Registered dietitian nutritionists (RDN) play a unique role in the management of overweight and obesity, and therefore training in undergraduate and dietetic internship programs is essential to prepare students to practice in an interdisciplinary setting. The registered dietitian nutritionist employs the nutrition care process[30] to assess a client's anthropometric, biochemical, nutrition-focused physical findings, food and nutrition-related history, personal, medical, family, and social history to determine nutrition diagnoses (articulated as a problem-etiology-signs/symptoms or P-E-S statement) and prioritize interventions and monitor and evaluate indicators and outcomes.[31] The RDN is able to not only compare usual dietary intake and physical activity to appropriate reference standards but also assess readiness to change, identify barriers to changing behaviors, and develop and implement effective evidence-based nutrition education and counseling interventions to promote weight management in individual, group, and worksite settings[31] A recent position paper about interventions for the prevention and treatment of pediatric overweight and obesity emphasized the need for RDNs working in this area of practice to have additional training in weight management strategies.[32] Therefore, didactic and

internship programs should provide students with multiple opportunities to develop skills in the nutrition care process through experiential learning.[12]

Brief overview of online learning

As early as 2000, researchers were reviewing the paradigmatic shift to internet-based learning in post-secondary colleges and universities.[33] Online learning contexts include adjunct (ie, enhances face-to-face classes), mixed or hybrid (ie, face-to-face and online formats nearly equal), or online only. Two attributes of online education that make this context appealing to students are place-independence (ie, students can access the course anywhere with an internet connection) and time-independence (ie, students can access the course at anytime when it is convenient) and thus learning is not constrained to the traditional classroom. The online context can also facilitate group communication.[33] An editorial by Sandon[34] in the Journal of the American Dietetic Association emphasized the impact of online education on adult learners who can access "learning at the time the learner needs it and is ready to learn." Sandon stated that well-designed internet-based educational programs meet all needs of adult learners, including "preference for problem-centered learning, real-life experience, being lifelong learners, varied learning styles, a desire for learning to be meaningful and applicable to their situation, and preferring to manage their own learning." In designing an online curriculum, educators should determine the needs of the intended audience; design the content based on criteria such as technological requirements of the web site or learning management system used and learner interactivity, as well as determine motivation and assessment strategies; develop the content (ie, multimedia, text files, instructions, resources); implement the curriculum, ensuring that learners are oriented to navigation and completion of the course; and conduct both process and summative evaluations.[34]

Several researchers have examined the effectiveness (or perceived effectiveness) of different online-learning formats, including asynchronous online discussions[35,36]; e-problem-based-learning[37]; and online modules or courses.[38-43] Zhan et al[36] looked at the effect of learning style on effectiveness of an online learning community, which was inherently collaborative. Students in the online learning community discussed assignments and readings online and completed other online activities. In this randomized controlled trial, the researchers found that both active (ie, prefer to learn through doing) and reflective (ie, prefer to think before doing) learners assigned to the online learning community group in an introductory digital design course performed better than their face-to-face discussion counterparts. However, while active learners performed better than reflective learners in the face-to-face group, reflective learners performed better than active learners in the online community. They concluded that an online learning community may improve learning outcomes for all learners but may be most effective for reflective learners.[36] A 2013 review by Thomas[35] found that most studies using asynchronous e-moderated discussions (ie, providing a discussion framework, clinical scenarios, or question and answer format) showed a positive, but small, learning outcome compared to a non-asynchronous online discussion control group.[35] Most emphasized reflective and critical thinking in their design, although none used the recommended scaffolded learning approach[44] to ensure that learners are familiar with both course or module content and the online process.[35]

Kim and Kee[37] evaluated students' satisfaction with and perceived effectiveness of twelve e-problem-based learning (e-PBL) modules in a problem-based curriculum at Sungkyunkwan University School of Medicine. The modules used interactive multimedia to engage learners and provide realistic problems. After the modules, students participated in a face-to-face colloquium to discuss the case. The majority of students considered the module to

be interesting, engaging, and realistic and were overall satisfied with the learning process. Most students spent 6-15 hours per module depending on the complexity of the problem. Students appreciated an increase in clinical reasoning skills through participating in the e-PBL modules. Researchers concluded that utilizing technology may be a cost-effective strategy to include more problem-based learning in a curriculum if time, faculty, and budget constraints prohibit development of a full PBL curriculum.[37]

Few studies seemed to measure changes in knowledge after participation in an online course or module. Chao et al[45] compared an online curriculum about delirium to a traditional lecture-based format and found a significant change from pre-test to post-test for both groups, but not a statistically significant difference between the groups. Similarly, Huckstadt and Hayes[41] found a statistically significant difference between pre-test and post-test scores for two interactive online modules for advanced practice nurses, although there was no control group comparison. Students were satisfied with the online case study experience, although technology issues, such as broken or down links, were cited as negative experiences.[41]

Likewise, Wallner et al[43] developed an online continuing education course about food safety issues of high-risk populations for registered dietitians, registered dietetic technicians, nurses, and extension educators and found a significant increase in knowledge from pre-test to post-test (67.3% vs. 91.9%). Initial differences in pre-test scores based on participants' profession (ie, nurses tended to score higher than other professionals and extension educators tended to score lowest) seemed to disappear at post-test.[43] Puri et al[46] utilized computer-assisted instruction (CAI) to facilitate dietetics students' learning about nutrition counseling techniques and found a small but statistically significant increase in knowledge from pre-test to post-test for the intervention group receiving the CAI modules. Similarly, Zubas et al[47] found that a

supplemental online tutorial about diabetes was effective in increasing nutrition science students' scores compared to students who only attended class lectures (10.7 ± 5.3 vs. 8.6 ± 4.5, $p = 0.04$).

Several studies have also examined the effectiveness of complete online courses or modules that were not designed as supplemental materials for face-to-face courses. A study by Wellnitz et al[48] examined changes in knowledge of dietitians specializing in pediatric nutrition who participated in an online module about standardized dietetic terminology and found a significant increase in score from pre-test to post-test (2.19 ± 1.75, $p < 0.001$). Similarly, Stark et al[49] assessed the effectiveness of a six-week facilitated online continuing education course about using an ecological approach to prevent childhood obesity for nutrition and health professionals and found a statistically significant change in knowledge, skills, and self-efficacy. Litchfield et al[50] incorporated three interactive online modules featuring simulations into their dietetic internship program. While they did not find a significant difference in change in score for two out of three modules, the researchers believed that students would perform better on "key-feature exams," which are designed to assess students' ability to complete a key step in clinical reasoning. A study by Francis et al[51] showed that students enrolled in an online didactic program in dietetics (DPD) performed significantly better on a final course exam compared to their face-to-face peers. Therefore, online learning can be at least as effective, if not more effective, than traditional face-to-face classes.

Many studies seek to determine student satisfaction with and explore students' experiences with online learning. For example, Rohwer et al[38] evaluated the perceived effectiveness of a 12-week online course about evidence-based medicine. Students indicated satisfaction with the module but a desire for more involvement of the online tutor, as well as participation by fellow students. Tutors, however, believed that most of the students were

engaged in the process. They noted that it was difficult to explain challenging concepts, such as critical appraisal, through e-mail or online discussion boards. Tutors desired more support for interactive activities, such as chat rooms, blogs, multimedia clips, and social media to enhance continued connection beyond the online module.[38] Premkuma et al[52] found that while medical students appreciated the flexibility of time afforded by a series of online modules about clinical epidemiology, they believed that there was not sufficient time for the number of assignments and amount of content provided in the modules.

Finally, online education may be more cost-effective for universities and other institutions. Maloney et al[53] designed and implemented two modules to train health professionals about fall prevention, one delivered in a traditional face-to-face setting and one delivered online. In this randomized controlled trial, the researchers found no significant difference in participation in the modules, participant satisfaction, knowledge, and change in practice. A break-even analysis showed that the online course was superior to the face-to-face course in terms of requiring fewer participants to cover costs associated with course delivery. However, economic analyses in terms of quality of knowledge gained (although the difference was small) and costs to participants (ie, in terms of additional time spent reviewing resources) favored face-to-face instruction.[53] In addition, there may be up-front costs association with development of online courses, such as investment in upgraded technology and other equipment to produce content, but may be recuperated depending on the scalability of the course.[54]

An overview of case-based and problem-based learning

Case-based learning is found in fields as diverse as health sciences, business, education, and law.[13] Case-based curricula provide students with simulated experiences in contexts that they will likely encounter in practice, which are essential to creating new knowledge and developing

skills.[55] Students become experts through practice, comparing previous experience to the current situation and self-assessment. Working through actual cases provides students the opportunity to actively problem-solve, develop differential diagnoses, and determine the best intervention.[55] However, the effectiveness of case-based approaches to learning has not been routinely reported. In the development of a conceptual framework for writing teaching cases, Kim et al[13] noted that of one-hundred reviewed reports of case-based learning, only fifteen studies included outcomes such as learners' knowledge and critical thinking skills. Many studies, however, include student feedback on cases,[13] which is often positive.[56,57]

Case-based learning is situated on a continuum between teacher-directed lecture-based instruction and student-directed problem-based learning.[56,58] In case-based learning, the student is guided through the inquiry process by predefined learning objectives,[58] and the learning is "scaffolded" through structuring the process into manageable "chunks" and providing resources to students.[59] It is often compared and contrasted with problem-based learning, which presents a problem to students first to drive learning.[58] In problem-based learning, students define their own learning objectives based on the problem or case presented to them and then work independently to meet these objectives with little facilitation from an instructor.[60] As mentioned above, case-based learning provides learning objectives for the case, and the instructor guides learning through structuring the process.[58] Both teaching methodologies are founded in constructivism, which sees students not as the recipients of knowledge from an instructor but as actively involved co-creators of their learning.[61] This epistemological view encourages development of critical thinking skills, as well as fosters collaborative learning through the social construction of knowledge.[61-64] Because knowledge acquisition is situated, case-based learning relies on case

studies to be as realistic as possible to facilitate learning of "real world" knowledge and skills.[13,65]

Both problem-based learning and case-based learning promote development of critical thinking skills and "deep learning." However, very few studies have reported differences in change in knowledge with either methodology. In discussing a systematic conceptual framework for developing a problem-based learning curriculum, Hung[66] notes that critics of problem-based learning focus on acquisition of knowledge, as several studies report that students in traditional learning curricula tended to perform better on tests of knowledge. Problem-based learning is more important for development of the reasoning process, as students tend to exhibit better clinical reasoning skills.[66,67]

Studies of case-based or problem-based learning in health professions

Several studies have reported utilization, effectiveness, and satisfaction with case-based or problem-based learning in healthcare-related curricula, such as medical and nursing schools.[13,56,57,68] Most studies report that students appreciate the realistic nature of cases[68] and ability to simulate real-world experiences that are difficult to duplicate in internships, such as a longitudinal case study of a geriatric couple who face challenges over several years that was delivered in a four-week medical clerkship[57] or ensuring equal access to experiences that may not be afforded by a practicum.[69] Few studies in nutrition have reported results of either problem-based or case-based learning. Lohse et al[70] examined the effectiveness of using two problem-based learning units compared to traditional lectures in a life cycle nutrition class. Students were stratified based on gender, coordinated or didactic program in dietetics, and performance on first exam (ie, score above or below median score) and randomly assigned to one of four treatment groups based on two factors – problem-based or lecture-based format and

infant nutrition or elderly nutrition presented first or second (to control for topic popularity or familiarity). Although there were no significant differences in knowledge retention after three months of study, researchers found that students in the problem-based learning groups showed more evidence of critical and reflective thinking and less reliance on memorization than their lecture-based counterparts. However, students in the problem-based learning group were more frustrated with their learning experience and confused by the process. The researchers suggested that students may need an adjustment period to become familiar with the problem-based learning formation, and thus a longer study period is warranted.[70] Terry and Seibels incorporated four problem-based learning modules into an undergraduate community nutrition class and found that "course content transfer did not appear to differ significantly from the regular case study approach" but that students perceived the problem as more realistic rather than "textbook knowledge."[71] Recently, Harman et al[72] examined student learning and perception of immersive case-based learning experiences in two upper-level dietetics courses. Data from three focus group discussions that included written responses were analyzed using thematic coding techniques. Researchers reported that the overarching theme of "Big Picture" was articulated through students' articulation of using a realistic story or scenario as a method to learning problem solving skills that will be used in future professional practice. Therefore, students seemed to recognize the development of critical thinking skills through case-based learning.[72]

Researchers have also examined methods to develop collaborative care skills of students. D'Apice et al[73] examined students' perception of learning after participating in an interdisciplinary, collaborative simulation training. The researchers found significantly higher perceptions of learning in the interdisciplinary simulation group compared to students who participated in a traditional laboratory exercise and concluded that this educational approach

afforded students the opportunity to receive training that is equal to other health care team members. Similarly, Johnson[74] evaluated students' experiences with a collaborative health care training curriculum in which 150 students from nutrition, nursing, physical therapy, and respiratory therapy participated. The students were assigned to teams to complete case studies and participate in simulations based on the case studies. Overall, students valued the experience as a method to develop collaborative skills for working as part of a medical care team.

Rationale, research question and hypotheses, and specific aims

If the prevalence of obesity, currently 35% of adults and 17% of children in the United States,[1] continues to increase, associated healthcare costs are expected to exceed $860 billion in 2030.[4] Health professionals are positioned to address this epidemic through client encounters. However, many health professionals may not have adequate training in obesity prevention and treatment.[8,18] Therefore, it is important for undergraduate programs that specifically target future health care professionals to include a comprehensive review of issues related to obesity prevention and treatment in their curriculum. In addition, the Council on Future Practice of the Academy of Nutrition and Dietetics recently proposed revising the undergraduate dietetics curriculum to include a practicum experience and other activities outside of class to foster students' critical thinking skills.[12] Undergraduate didactic programs must explore innovative methods (ie, online case studies) for providing experiential learning opportunities within the confines of current budgetary and schedule constraints. Case-based curricula simulate real-world experience within a guided framework to facilitate learning of knowledge and skills.[55] However, few studies in the health sciences literature have evaluated the effectiveness of case-based study.[13] Therefore, this research project sought to fill in the gaps in knowledge related to the effects of case-based learning on students' knowledge and skills associated with obesity

prevention and treatment through innovative collaborative online case-based learning modules. The facilitated case studies employed scaffolded skill development as students received small pieces of information about the case over time and provision of supplemental content and direction to appropriate internet resources. Students collaborated asynchronously through online discussions and completion of online group projects. This project used a mixed-methods research design to develop and pilot-test the modules.

The research question was "How does an online case-based learning module impact students' knowledge and skills related to obesity prevention and treatment?" The overall hypothesis was that case-based learning that incorporates collaborative learning and active reflection would increase students' knowledge and skills associated with obesity treatment and prevention. The overall hypothesis was tested in students enrolled in senior level nutrition courses at the University of Georgia. The specific aims were:

Specific Aim 1. Determine current knowledge and attitudes towards obesity of students in introductory and senior level courses in nutrition. *It was hypothesized that students who were dietetics or nutrition science majors would score higher on an obesity knowledge scale and have less negative outcomes expectancies towards obesity than non-major students and that students in a senior level practice-oriented nutrition class would score higher on an obesity knowledge scale and have less negative outcomes expectancies towards obesity than students in an introductory course in nutrition.*

Specific Aim 2. Determine changes in knowledge and skills about obesity prevention and treatment related to participation in an online case-based learning module in senior-level nutrition courses. *It was hypothesized that student knowledge and skills related to obesity*

prevention and treatment would increase as a result of participating in an online case-based learning module.

Specific Aim. 3. Assess student perceptions of participating in an online collaborative case-based learning module. *It was hypothesized that students would value the online case-based learning module as an opportunity to participate in a series of simulated patient encounters that incorporates a multidisciplinary approach because previous studies showed that medical students appreciated a similar longitudinal case study approach.*[57]

Rationale for Curriculum Design

The online case-based modules integrated a constructivist learning paradigm that posits knowledge or meaning is constructed by the learner based on previous experience.[61,62,75] Therefore, each module began and ended with reflective exercises to stimulate self-evaluation. The instructor was viewed as a "facilitator of learning" who "scaffolds learning" by carefully designing activities to guide the student through the process of learning.[75] Adaptive scaffolding, such as encouraging students to activate prior knowledge, has been shown to be effective in fostering knowledge acquisition and self-regulated learning.[76] Students were first introduced to the case study family and the nutrition-related problem(s) through a PowerPoint® presentation. In each of the sub-modules, which were delivered sequentially every 2-3 days over the course of three weeks, students gained additional information about the case as well as supplemental PowerPoint® presentations about topics pertinent to the case or guiding questions for discussion board posts to facilitate students' reasoning skills. Students received information about the case in the order in which a practitioner would review or collect information. The facilitator read each group's posts and generated additional discussion by posing new questions to students on the discussion board. The facilitator also may have posted additional information to the discussion

board to correct misconceptions or incorrect information posted by students. In addition, the facilitator provided feedback for the group projects. The guiding questions often required students to generate their own questions about what information they needed to know to help the case study family. Such guiding questions facilitated learning by helping students seek relevant information.[77] Students were encouraged to develop knowledge through cooperation and collaboration by participating in online discussion boards in which they were required to post an original response to the guiding questions and respond to at least two other students. Students also developed educational materials or completed patient progress notes as a group to foster collaboration. Litchfield[50] notes that collaboration and cooperation are key components of the dietetic internship program, as students learn from sharing experiences with each other and develop valuable communication and critical thinking skills. Cases were developed by two registered dietitians to reflect typical situations found in dietetic practice and reviewed by the faculty member who included the modules in two of his courses. There was precedent for the use of real-world experiences so that students would hopefully perceive that the cases represented realistic stories and situations that they may encounter as future practitioners.[68] A full description of each module and its associated learning objectives and activities is included in subsequent chapters.

Overview of Mixed Method Research Design

In beginning a research study, it is important to articulate the theoretical assumptions and paradigmatic stance on which the inquiry rests in order to align the research purpose, data collection and analysis methods, and conclusions or warranted assertions deemed appropriate.[78] The nature of paradigmatic stances and mental models, especially regarding the appropriateness of mixing such stances or models, is a contested issue in the mixed methods research

literature.[78,79] The following discussion summarizes two paradigmatic stances that were appropriate for this project.

The complementary strengths stance posits that mixing methods in a given study is possible but that the two strands must remain separate in order to maintain their complementary strengths and offsetting weaknesses.[78,79] Each paradigm consists of philosophical assumptions that guide inquiry practice, and these paradigms differ in important ways. Thus, the methods relating to these paradigms should be implemented separately.[78] This stance was appropriate because this project consisted of three different phases: assessment of current knowledge, skills, and attitudes; change in knowledge and skills related to participation in the modules; and evaluation of students' experience and satisfaction with the modules. The first phase sought to determine current knowledge, skills, and attitudes related to obesity prevention and treatment of both introductory nutrition students and advanced practice nutrition students (quantitative) in an effort to determine the starting point for students and potentially inform modification of the modules. The second phase sought to determine changes in knowledge, skills, and attitudes after participating in an online case-based learning module using predominantly quantitative methods (pre-test/post-test) but complementary qualitative methods in assessing students' perceived learning collected through self-evaluation journal entries. The third phase sought to examine students' perceptions of participating in the collaborative online case-based learning modules (qualitative and quantitative). The methods were conducted separately without one informing the other, for the most part. The results from the study of student perceptions (qualitative) helped interpret the changes in knowledge and skills (quantitative) with either convergent or divergent findings.

The a-paradigmatic stance was most relevant for this study (and was indeed the chosen stance). This stance is the opposite of the purist stance in that paradigms help inform a researcher's development of methodology but only in general ways.[78] The research question, purpose, and context guide the selected methods more than a philosophical framework. According to Greene [78] the majority of mixed methods research may be conducted within this framework. The modules for this study were based on constructivist theory in that students were guided in developing their own knowledge through reflection and self-evaluation activities. However, the efficacy of the modules was tested using postpositivist methods (ie, knowledge test) because key stakeholders needed to include such numerical data in the final report. On the other hand, the researcher believed that some students do not perform well on tests, so analysis of self-reported knowledge gains and knowledge needs also tested the efficacy of the modules and explained how the modules impacted knowledge. Students' perceptions were examined as potential mediators of learning. There was no single substantive or higher order theory that guided this project, but different aspects of the students' experiences with learning were examined using a combination of quantitative and qualitative methods to address different but related questions to efficacy of the modules. The methods chosen answered key evaluation questions of both the stakeholders and the researcher.[78]

Mixed-Method Study Design

The purposes for this mixed methods project were development, complementarity, and expansion.[78] In a study with the purpose of development, the results of one method inform the other method.[78] The preliminary focus groups with advanced practice students in FDNS 4500 examined students' experiences with both case studies and collaboration, especially related to the utility of case studies and the facilitators and barriers of effective collaboration (and perhaps the

value of collaboration). Results of these discussions were intended to inform the development of the case study evaluation survey (quantitative) to measure students' perceived satisfaction with the collaborative online case study modules. However, because only one student participated in the focus group, the data were not analyzed. The student satisfaction survey was developed based on questions the researcher believed pertinent to the case-based learning and delivery of the modules. Finally, results from the case study evaluation survey guided questions asked in the post-case-study focus groups to assess students' experiences with the modules. This project also sought complementarity[78] in assessing student knowledge, as both objective tests and subjective perceptions of gains in knowledge were assessed. Finally, this project sought to expand the understanding of student learning in the context of an online collaborative case study.[78] The purpose of expansion refers to the examination of different phenomena within one study. In this case, the researcher sought to make a connection between effective collaboration as a mediator of gains in knowledge.

The overall design of the project was a sequential explanatory design.[80] In this design, quantitative data is typically collected and analyzed with collection and analysis of qualitative data occurring afterwards. The mixing occurs in the interpretation phase.[80] The pre-test/post-test data (quantitative) was collected toward the beginning of the semester and within one week of completing the module, followed by the reflective essays of learning (qualitative data), and the case-study evaluation surveys (quantitative) were collected before the focus groups were conducted. Priority was given to the quantitative data, although the qualitative data expanded understanding of the quantitative results. The results of both quantitative and qualitative methods were integrated to determine the effects of the curriculum on students' learning and overall satisfaction with the online modules.

Table 2.1. Project overview

Course	Course Title	Study Participation	Semester
FDNS 2100	Human Nutrition and Food	Pre-Project Phase	Spring 2013; Fall 2013
FDNS 4050	Optimal Nutrition for the Lifespan	Phase 1 Phase 2	Fall 2013
FDNS 4500	Medical Nutrition Therapy I	Pre-Project Phase; Phase 1 Phase 2	Fall 2013
FDNS 4520	Clinical Nutrition Interventions	Phase 1 Phase 2	Spring 2014
FDNS 4540	Public Health Dietetics	Phase 1 Phase 2	Spring 2014

Statement of Subjectivity

I am a graduate of both the didactic program in dietetics and combined Master of Science/Dietetic Internship programs at the University of Georgia. Therefore, I have participated in most of the same classes as students in this study. In designing the case study modules, I wanted to address issues that I found troublesome with case studies, particularly in the advanced nutrition classes. I was particularly interested in ensuring that all students were involved in each part of the case study, as my experience was dividing the case study question among group members to complete and thus feeling that I had not learned everything that I needed to learn from the case study.

As I analyzed the data from self-evaluation of learning, open responses on student satisfaction survey, and focus groups, I was aware that not all students shared my background nor experience with case-based learning. I intentionally analyzed data from focus groups and reflective essays at least 3-4 months after collection to ensure distance from the collection of data and allowed myself to objectively read students' statements. In addition, I read each reflective essay multiple times to look for themes, and I noted when themes resonated with me and when

they conflicted with my ideals to ensure that I understood how my background and values were influencing my interpretation. I used memos to document my analyses, and I used constant comparison of the thematic coding to ensure that I generated all themes possible.[81]

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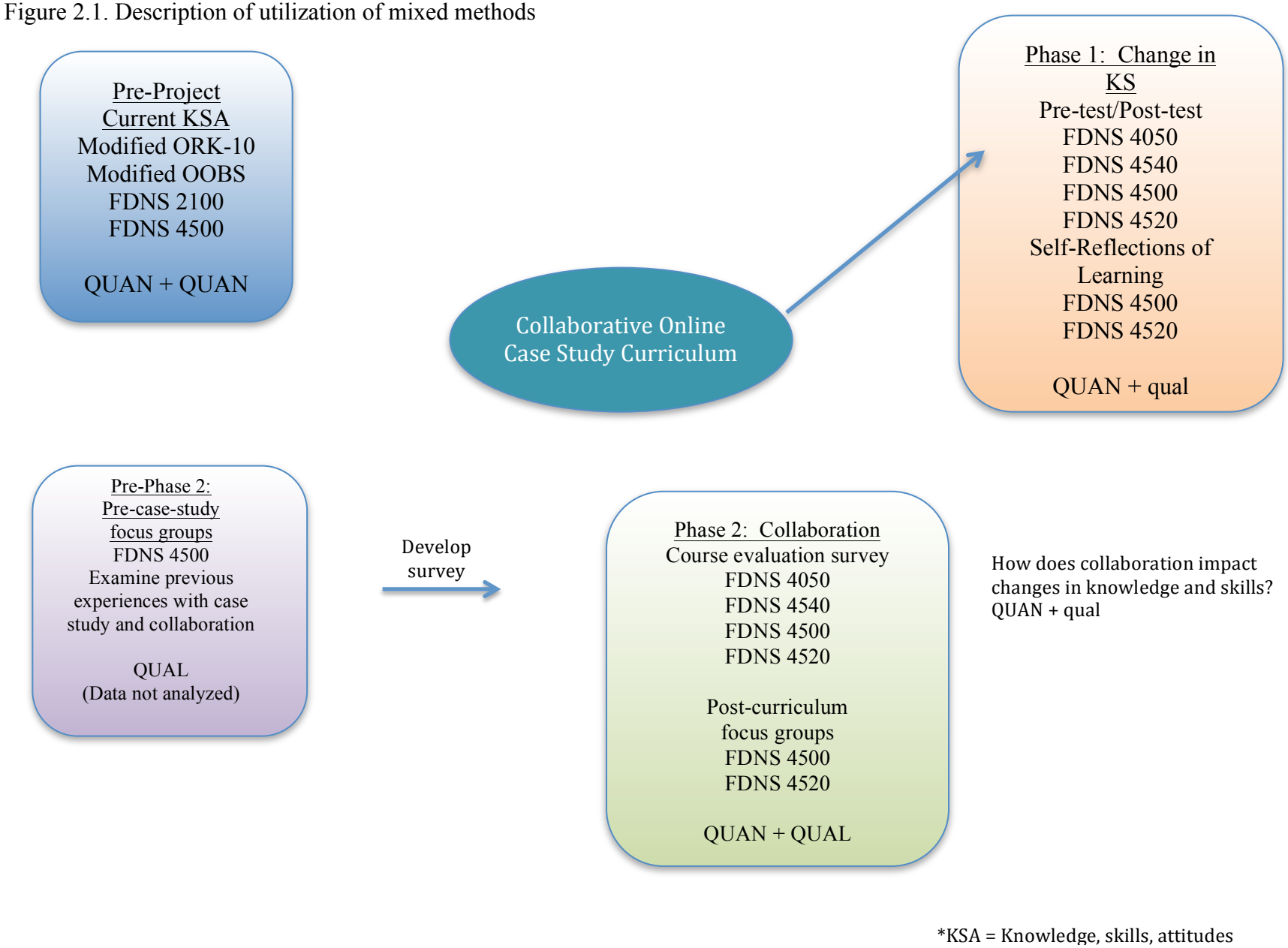
Figure 2.1. Description of utilization of mixed methods



CHAPTER 3

WHAT DO UNDERGRADUATE STUDENTS KNOW ABOUT OBESITY?[1]

[1] Bignell, W.E. and J.G. Fischer. To be submitted to *Journal of Nutrition Education and Behavior*.

Abstract

Objective: To determine current knowledge of obesity-related health risks and beliefs about the health costs of obesity of undergraduate introductory (Intro) and advanced nutrition students.

Design: Cross-sectional online survey using a modified Obesity-Risk Knowledge (ORK-10) scale and modified Obesity Outcomes Expectancy scale.

Setting: Intro and advanced nutrition classes at a large research university.

Participants: A convenience sample of 431 students and 45 students enrolled in introductory and advanced nutrition courses, respectively.

Variables Measured: Knowledge of obesity-related health risk score, beliefs about benefits of weight loss.

Analysis: T-test, one-way ANOVA (significance $p < 0.05$), frequency analysis.

Results: Students in the advanced class scored significantly higher on the modified ORK-10 scale than did students in Intro classes (84.6% ± 11.7 vs. 70.4% ± 12.8, respectively, $p < 0.001$). At least 73% of students in both Intro and advanced classes agreed or strongly agreed with the statements about the benefits of weight loss.

Conclusions and Implications: A high percentage of undergraduate students know of general health risks associated with obesity.

Keywords: obesity knowledge, college students

Introduction

Obesity continues to be considered a major public health issue within the United States, as 34.9% of adults and 16.9% of children and adolescents were considered obese in 2011-2012.[1] Excess adiposity is a well-known risk factor for multiple chronic health conditions, including hypertension, type 2 diabetes mellitus, certain cancers, and infertility.[2] Children who are obese are also at risk for type 2 diabetes, high cholesterol, hypertension, gallstones, fatty liver disease, and asthma and are more likely to continue to be obese in adulthood.[3] Obesity-related chronic health conditions are associated with increased medical costs, disability, decreased health-related quality of life, and early mortality.[4,5] If trends in obesity continue, associated medical costs are expected to exceed $860 billion by 2030, which will account for 16-18% of all U. S. healthcare costs.[6] Because obesity results from the interplay of multiple, multi-level factors,[2] the Centers for Disease Control and Prevention (CDC) recommends strategies to prevent obesity at the individual, family, and community levels.[7] These strategies underscore the importance of involving all Americans in obesity prevention to reach the 2020 *Healthy People* targets for percentage of adults (30.5%) and children and adolescents (14.5%) who are obese.[8]

Unfortunately, the majority of Americans may not be aware of many of the health risks associated with obesity. Results of a survey of 1,011 adults by the Associated Press-NORC Center for Public Affairs Research published in January 2013 indicated that few respondents were aware of the link between excess weight and cancer, respiratory diseases, hypertension, hypercholesterolemia, arthritis, or infertility.[9] Knowledge of health risks associated with a chronic condition is considered a component of the behavior change cycle, and physicians are encouraged to advise their patients of such health risks.[10] For example, in the 5 A's model, physicians assess obesity-risk related behaviors, advise patients of health risks and benefits of

behavior change, agree to collaboratively set goals and determine patient's confidence to change, assist the patient with behavior change by providing information, support, or referrals, and arrange for follow-up.[10] About half of the participants in the AP survey had discussed obesity-related health risks with their physicians, but the percentage of respondents who were overweight or obese was not reported.[9]

Therefore, efforts to educate Americans about the health risks of obesity must include a variety of settings and target audiences. One such target audience is undergraduate students, as they will become the next generation of parents, teachers, healthcare providers, policy-makers, and leaders and will be well positioned to institute change. However, little is known about the average undergraduate student's knowledge of obesity-related health risks, which is important to understand before designing a curriculum to address this need. Previous studies have examined obesity health risk knowledge of trainee health care professionals in the United Kingdom,[11] African-American nursing students,[12] low-income women,[13] and obese adults in a weight management program.[14] Other studies have examined undergraduate students' knowledge about the metabolic syndrome[15] and heart disease.[16] However, no studies assessing the knowledge of obesity-related health risks of the general undergraduate student population were found.

In addition to knowledge, a person's beliefs or attitudes may also influence health behaviors.[8,14] A study by Swift et al[14] found that weight loss of participants attending a specialist weight management service was associated with a stronger endorsement of the health and social/aesthetic costs of obesity. No studies examining undergraduate students' beliefs about the health costs of obesity, such as requiring more medical care or being less active than a person with ideal body weight,[17] were found, although studies have reported dietetic students' weight reduction beliefs, such as losing weight to improve appearance and self-esteem.[18]

The purpose of this study was to assess the current knowledge and beliefs about obesity and its associated health risks of undergraduate students in an introductory nutrition course (Intro) and upper-level dietetics course (Advanced). It was hypothesized that students in the Advanced course would have greater knowledge of health risks associated with obesity compared to the Intro nutrition students. It was also hypothesized that students in majors in the Department of Foods and Nutrition would have greater knowledge of obesity-related health risks compared to their non-major peers. Finally, it was hypothesized that students in Foods and Nutrition would have stronger agreement with statements linking obesity to health costs.

Methods

Study Design and Survey Development. This cross-sectional study utilized an online survey to assess introductory and advanced nutrition students' knowledge of health risks associated with obesity and beliefs about the benefits of weight loss. The modified Obesity Risk Knowledge (ORK-10) scale was adapted from the Obesity Risk Knowledge (ORK-10) scale,[19] a validated instrument measuring knowledge associated with health risks of obesity. One item from the original ORK-10 was omitted because it referred to a population that was not applicable within the United States (the scale was developed for use in the United Kingdom).[19] A question about defining obesity with body mass index (BMI) was added. In addition, the wording of one item was changed from "bowel cancer" to "colorectal cancer," as that terminology is used more frequently within the United States. In addition to the nine items from the original 10-item ORK scale and question about BMI classification, ten additional items were developed to assess knowledge of obesity-related health risks during preconception, pregnancy, and childhood/adolescence. These important health risks were selected based on information from the Centers for Disease Control and Prevention web sites about adult obesity[2] and childhood

obesity[3] and *2009 Position of the American Dietetic Association and American Society for Nutrition: obesity, reproduction, and pregnancy outcomes.*[20] The additional true/false/don't know survey items were reviewed by a team of four nutritional science faculty experts for content validity and clarity. In addition, four 7-point Likert-scale items from the original Obesity Outcomes Expectancy Health Benefits of Weight Control subscale[21] and two additional statements were included to assess students' beliefs about obesity and its health costs. The levels of agreement were strongly disagree, disagree, moderately disagree, neither agree nor disagree, moderately agree, agree, and strongly agree.

Survey Collection. Students in three introductory nutrition classes (Intro), one during Spring and two during Fall 2013 semesters, were invited to participate in the study for extra credit. An alternative extra credit opportunity was offered to students who did not wish to participate in the study. Interested students e-mailed the researcher for a link to the survey hosted by SurveyMonkey.com®. Consent was obtained through students' response to the first question, "Yes, I agree to participate in this study" after reading a consent script. Students in an upper-level dietetics class (Advanced) during the Fall 2013 semester also completed the survey as part of a pre-test for an online case study module. These students had already completed the introductory nutrition class and had taken at least one additional upper-level nutrition course. Consent from these students was obtained via a signed consent form. All procedures and protocols were approved by the Human Subjects Institutional Review Board at the University of Georgia.

Data Analysis. Survey results were analyzed using SPSS version 22 for Mac (IBM, Armonk, NY). Responses for the modified ORK-10 scale were initially coded as correct, incorrect, or do not know/skipped. To calculate a total score, correct answers were assigned 1

point, and incorrect and "do not know" or skipped responses were assigned 0 points for a maximum score of 20 points. Frequencies of correct, incorrect, and "do not know" answers were calculated for each question, as well as for each agreement level of the Obesity Outcomes Expectancy scale. Demographic data (gender, year in college, major, and race/ethnicity) were also reported. Intended or declared college major was coded as Foods and Nutrition (Dietetics, Nutrition Science, or Consumer Foods), Exercise Science (Exercise and Sport Science or Athletic Training), Health Promotion and Behavior, Human Development and Family Sciences, Other Science/Health (i.e., Biology, Pre-Med, Pre-Nursing, Pre-Physician Assistant, Psychology, etc.) or Other/Undecided/No Response (i.e., English, History, Business). A t-test or one-way analysis of variance was conducted to determine any differences in modified ORK-10 score based on demographic data for Intro classes and enrollment in introductory versus upper-level nutrition courses. Because the data were not normally distributed, non-parametric tests were also conducted, which showed similar significance statistics to parametric tests (data not shown). Therefore, parametric tests are reported. Statistical significance was determined based on a two-sided p-value <0.05.

Results

Participant characteristics. A total of 431 students in Intro classes and 45 students in the Advanced class agreed to participate in the study (Table 3.1). The majority of students in both classes were female (80% Intro and 91% Advanced). Overall, students were 75% non-Hispanic white, 9% Asian, 6% Non-Hispanic black, and 5% other race/ethnicity. As expected, most students in the Advanced class were fourth- or fifth-year undergraduates majoring in dietetics. The majority of students in Intro classes were second- or third-year undergraduates and only

13% were majoring in foods and nutrition. Almost 25% of these students indicated majoring in a field outside of health or science.

Modified ORK-10 Score. There was no significant difference in modified ORK-10 score in Intro classes for any demographic variable except semester of enrollment (Table L.1). As expected, students in the Advanced class scored significantly higher on the modified ORK-10 than did students in Intro classes (84.6% ± 11.7 vs. 70.4% ± 12.8, respectively, $p < 0.001$) (Table L.2). Most students in Intro classes had some knowledge of general health risks associated with obesity, such as hypertension and decreased life expectancy (Table 3.2). However, the Advanced class students had greater knowledge of specific obesity-related health risks, such as increased risk for certain cancers and infertility. Advanced class students also demonstrated greater understanding of assessment of obesity, such as the BMI criterion for obesity and importance of fat distribution for health. Students in the Advanced class also understood the recommendation for weight loss in patients with diabetes. These students were able to discriminate between health conditions associated with obesity and those that were not, such as food allergies and autism. Interestingly, a greater percentage of students in the Intro classes recognized that obese children are more likely to develop type 2 diabetes.

Obesity Outcomes Expectancies Benefits of Weight Control Sub-scale. The majority of students in both Intro and Advanced classes agreed or strongly agreed with the six statements about the benefits of weight loss (Table 3.3). Students in the Advanced class tended to hold stronger beliefs about the cost of medical care associated with obesity, with 93% agreeing that "an obese person needs more medical care" and 80% agreeing that "losing weight would decrease medical expenses for obese people" compared to 81% and 74% of Intro students, respectively. Students in Intro classes tended to hold stronger beliefs about the importance of

achieving "ideal bodyweight," as 87% agreed that a "person with an ideal bodyweight can lead a more active life" compared to 78% of Advanced students.

Discussion

Overall, most students in the introductory nutrition class showed at least some knowledge about the health risks associated with obesity. Over half of students indicated that they were majoring in a health-related field, although there were no significant differences in modified ORK-10 score based on intended or declared major for students in Intro classes. This finding is similar to what Swift et al[11] found when comparing baseline knowledge of trainee health care professionals (nurses, doctors, and dietitians) in the United Kingdom. In the first year of study, there was no significant difference in ORK-10 score among the student groups; however, by the final year, dietetic students showed a significantly higher score compared to their fellow trainee counterparts.[11] While we did not examine obesity-risk knowledge of upper-level dietetic students compared to fellow pre-medical students in the final year, we did show that these fourth- and fifth-year undergraduates scored significantly higher compared to the introductory nutrition students, which is also in agreement with the previous study that showed significantly greater ORK-10 scores in the final year compared to first year of study for all student groups.[11]

It was assumed that students in Intro classes represented a "general student population" that may not have been exposed to specific information about obesity-related health risks. However, students' scores were higher than previously reported studies of the general lay population, with average scores of 71.3% ± 15.5 (Table L.3) on the original ORK-10 survey items. For example, Rahman et al[13] showed that low-income women, almost 35% of whom had attended some college, had mean ORK-10 scores between 53% and 59% dependent on race, and Swift et al showed that participants in a weight loss program in the United Kingdom scored 42%

compared to a control community sample (38%).[14] Similarly, though, fewer participants in the study by Rahman et al understood recommendations for weight loss and diabetes, the importance of fat distribution, or the association between obesity and cancer.[13]

Other studies have examined undergraduate students' knowledge about health conditions associated with obesity. For example, Yahia et al[15] assessed students' knowledge about the metabolic syndrome, and several questions were related to obesity. Over 90% of students recognized that obese individuals were at risk for myocardial infarction, while 84% identified obstructive sleep apnea as a possible consequence of obesity.[15] The sample in this study was similar to our sample, with approximately 51% majoring in a health science and 40% in their first or second year of college. Muñoz et al assessed undergraduate students' knowledge of cardiovascular disease causes and prevention.[16] The researchers found that the majority of students identified being overweight as a risk factor for cardiovascular disease (84%), and that losing weight (83%) or getting physical activity (93%) would prevent or reduce the risk of developing cardiovascular disease.

Studies have reported healthcare professionals' beliefs and attitudes about obesity, especially causes[22] and attitudes towards obese patients.[23-25] Most of the studies indicated that many healthcare professionals exhibit some weight-based bias or at best neutral attitude toward obesity, often believing that weight is under a person's control. The lay population, however, may attribute obesity to biological factors.[22] Therefore, in addition to educating undergraduate students about the causes and consequences of obesity, it is also necessary to foster a neutral or positive attitude toward the obese person. Our study did not assess students' level of weight-based bias; however, students did show strong recognition of the health costs of obesity. It is possible that these beliefs may negatively influence conversations with family, colleagues, or

future patients. Upper-level dietetic students did not show as strong of an endorsement for the belief that a person with an ideal bodyweight can lead a more active life, which perhaps indicates an acceptance that one does not have to reach a weight goal in order to enjoy a healthier lifestyle.

There were several limitations to this study. It was a cross-sectional study in which we did not assess students' own BMI and lifestyle habits. Therefore, we were not able to make associations between students' knowledge/beliefs and their weight. We also did not assess students' previous exposure to obesity prevention campaigns to determine if such campaigns were related to the relatively high knowledge of obesity-related health risks. A study by King et al[26] showed that knowledge of the waist circumference associated with increased risk for chronic disease increased after implementation of the "Measure Up" mass media campaign in New South Wales, Australia. So, it is possible that students had previous exposure to media coverage of obesity-related health risks. We also assessed a single metric of beliefs about obesity costs (health costs) in order to prevent the survey from being too long, which could potentially have deterred students from completing it and thus limited our sample size. An interesting finding in our study was that a greater percentage of students in Intro classes recognized that children with obesity are more likely to develop type 2 diabetes. It is possible that advanced students misread this question, as the "not" in the question was not bolded as in similar questions. Finally, our sample was predominantly female and the majority was non-Hispanic white, so results may not be generalizable to a more diverse student population. Future studies should assess additional aspects of beliefs about obesity and weight control, in addition to collecting information about students' BMI, eating and physical activity habits, and exposure to obesity prevention campaigns.

Implications for Research and Practice

In our study, we found that the majority of undergraduate students in an Intro course have some knowledge of the health risks of obesity. In developing a curriculum to teach students about obesity prevention and treatment, it will be important to include additional information about health conditions throughout the lifespan associated with obesity in an effort to raise students' awareness of the true risks of excess adiposity. It will also be important to include recommended strategies and goals for obesity treatment, as many of our students believed a person would have to lose a significant amount of weight to see health benefits. Finally, it is important to include activities to help students develop a positive focus for obesity prevention and treatment in order to decrease development of weight-based bias.

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Table 3.1. Characteristics of participants in introductory and advanced nutrition classes

	Intro n (%*)	Advanced n (%*)	*P*-Value
Gender			0.08
Female	345 (80)	41 (91)	
Male	85 (20)	4 (9)	
Race or Ethnicity			0.53
Asian American	43 (10)	2 (4)	
Hispanic	14 (3)	3 (7)	
Non-Hispanic black	26 (6)	3 (7)	
Non-Hispanic white	320 (74)	36 (80)	
Other	23 (5)	1 (2)	
Prefer not to answer or no response	5 (1)	0 (0)	
*Year in College***			**<0.001**
First year undergraduate	55 (13)	0 (0)	
Second year undergraduate	135 (31)	0 (0)	
Third year undergraduate	161 (37)	1 (2)	
Fourth year undergraduate	69 (16)	29 (66)	
Fifth year or beyond undergraduate or graduate student	11 (3)	14 (32)	
*Intended or Declared Major***			**<0.001**
Foods and Nutrition	56 (13)	45 (100)	
Exercise Science	83 (20)	0 (0)	
Health Promotion and Behavior	47 (11)	0 (0)	
Human Development and Family Sciences	48 (11)	0 (0)	
Other Science/Health	85 (20)	0 (0)	
Other/Undecided/No Response	104 (24)	0 (0)	

*Percentages may not sum to 100 due to rounding.
**Some participants did not provide a response

Table 3.2. Knowledge about obesity-related health risks (scores on modified ORK-10 questions by class of enrollment) (χ^2)

	Intro (n = 431)	Advanced (n = 45)	*P*-Value
	Correct	**Correct**	
1. Adults are considered obese if their body mass index (BMI) is 30 or greater [True]	*346 (80)	45 (100)	**0.001**
2. A person with a "beer gut" has an increased risk of getting diabetes [True]#	324 (75)	37 (82)	0.29
3. Obesity increases the risk of getting colon cancer [True] #	338 (78)	38 (84)	0.35
4. An obese person who gets diabetes needs to lose at least 40% of their body weight for clear health benefits [False] #	175 (41)	40 (89)	**<0.001**
5. Obese people can expect to live as long as non-obese people [False] #	408 (95)	42 (93)	0.71
6. Obesity increases the risk of getting breast cancer after menopause [True] #	225 (52)	31 (69)	**0.03**
7. There is no major health benefit if an obese person who gets diabetes loses weight [False] #	388 (90)	44 (98)	0.09
8. Obesity does not increase the risk of developing high blood pressure# [False]	421 (98)	45 (100)	0.30
9. It is better for a person's health to have fat around the hips and thighs than around the stomach and waist [True] #	262 (61)	43 (96)	**<0.001**
10. Obesity increases the risk of getting a food allergy [False] #	186 (43)	41 (91)	**<0.001**
11. Obesity increases the risk of infertility in women but not men [False]	183 (43)	34 (76)	**<0.001**
12. A woman who is obese prior to pregnancy is more likely to have an obese child [True]	282 (65)	31 (69)	0.64
13. Excess weight gain during pregnancy is not associated with a child's risk of being obese [False]	122 (28)	28 (62)	**<0.001**
14. Overweight children are more likely to be even more obese adults [True]	383 (89)	42 (93)	0.36
15. Obese children are not more likely to develop type 2 diabetes [False]	373 (87)	31 (69)	**0.002**
16. Obese children are more likely to have asthma [True]	340 (79)	40 (89)	0.11
17. Children with autism are more likely to be obese [False]	242 (56)	36 (80)	**0.002**
18. Obesity increases a child's risk of getting gallstones [True]	242 (56)	27 (60)	0.62
19. Excess body weight can affect the shape and strength of a child's bones [True]	406 (94)	42 (93)	0.81
20. Obese children are more likely to have poor self-esteem, which often continues into adulthood [True]	422 (98)	44 (98)	0.95

*All frequencies shown as n (%)
#Denotes question from original ORK-10 scale

Table 3.3. Students' obesity outcome expectancies of the health benefits of weight loss (Intro vs. Advanced) (χ^2)

	Strongly Disagree % (n)	Disagree % (n)	Moderately Disagree % (n)	Neutral % (n)	Moderately Agree % (n)	Agree % (n)	Strongly Agree % (n)
Obesity prevents a person from getting the most out of life							
Intro	1 (3)	1 (3)	2 (9)	4 (16)	14 (62)	33 (144)	45 (194)
Advanced	0 (0)	0 (0)	0 (0)	7 (3)	18 (8)	29 (13)	44 (20)
An obese person needs more medical care							
Intro	1 (2)	0 (0)	2 (9)	2 (10)	15 (63)	38 (162)	43 (185)
Advanced	0 (0)	0 (0)	0 (0)	2 (1)	4 (2)	40 (18)	53 (24)
*People should maintain an ideal body weight for optimal health**							
Intro	0 (1)	0 (1)	1 (2)	2 (8)	5 (20)	20 (85)	73 (314)
Advanced	0 (0)	0 (0)	0 (0)	0 (0)	11 (5)	29 (13)	58 (26)
*Losing weight would greatly improve obese people's health**							
Intro	0 (1)	1 (2)	1 (2)	1 (3)	10 (43)	30 (127)	59 (253)
Advanced	0 (0)	0 (0)	0 (0)	0 (0)	11 (5)	20 (9)	64 (29)
*A person with an ideal bodyweight can lead a more active life**							
Intro	0 (0)	1 (5)	1 (3)	2 (8)	9 (40)	25 (107)	62 (268)
Advanced	0 (0)	0 (0)	0 (0)	7 (3)	9 (4)	33 (15)	44 (20)
Losing weight would decrease medical expenses for obese people							
Intro	0 (0)	1 (2)	2 (7)	7 (32)	17 (73)	28 (121)	46 (196)
Advanced	0 (0)	0 (0)	0 (0)	4 (2)	16 (7)	36 (16)	44 (20)

*P <0.05

CHAPTER 4

"SO MANY FACTORS CONTRIBUTE TO YOUR WEIGHT": STUDENTS LEARN ABOUT OBESITY IN AN ONLINE CASE STUDY MODULE[1]

[1]Bignell, W.E. and J.G. Fischer. To be submitted to *Journal of Nutrition Education and Behavior*.

Abstract

Objective: To determine changes in students' knowledge of obesity management topics and satisfaction with learning experience after participating in an online facilitated, scaffolded, asynchronous collaborative case-based learning (CBL) module.

Design: Online pre-test/post-test study design, student satisfaction survey, and content analysis of students' self-evaluation of learning essays.

Setting: General life cycle nutrition class at a large research university.

Participants: A convenience sample of 86 students enrolled in a life cycle nutrition class for nutrition and non-nutrition majors were randomly assigned to groups of 6 to participate in discussion boards and group activities.

Intervention(s): Students participated in an online CBL module with information about the case study family delivered incrementally over three weeks.

Variables Measured: Changes in students' knowledge of obesity management topics, students' satisfaction with learning experience, students' perceived learning.

Analysis: Paired t-test, t-test, one-way ANOVA (significance $p < 0.05$), frequencies, qualitative content analysis.

Results: There was a significant increase in score ($+10.2\% \pm 11.1$, $p < 0.001$) that was greater for students with lower pre-test scores ($+18.6\%$ vs. 3.9%, $p < 0.001$). Students expressed learning that multiple factors impact weight and were satisfied with the learning experience.

Conclusions and Implications: Online facilitated collaborative CBL effectively increased knowledge of obesity management topics and was perceived by the majority of students as a satisfactory learning experience contributing skills needed for pediatric obesity management.

Keywords: online education, case-based learning, pediatric obesity, college students

Introduction

In the United States, obesity continues to be a major public health issue, as over 35% of adults and 17% of children and adolescents are considered obese.[1] Because obesity is associated with multiple chronic diseases, such as heart disease, type 2 diabetes, and obstructive sleep apnea,[2] related health care costs will continue to increase if current trends are not reversed.[3] It is especially important to prevent excess weight gain in children, as obesity increases a child's risk for developing hypertension, type 2 diabetes, joint problems, sleep apnea, gallstones, and other health problems.[4] In addition, being overweight in childhood increases the risk for continued weight gain in adulthood.

Obesity prevention and treatment are challenging due to the multifactorial nature of the disease. While genetics likely plays a role in development of obesity, there are many other individual, family, community, and environmental factors impacting weight.[2] Because multi-level factors influence weight, effective interventions rely not only on healthcare providers but also the general population to support behavioral changes within their families and communities. Key target audiences to effect change are undergraduate students in nutrition and health-related majors, who will become the next generation of healthcare providers, teachers, parents, policy makers, business leaders, and community advocates. Therefore, it is important for an undergraduate nutrition curriculum to include course content giving these students a working knowledge of the health risks and consequences associated with obesity, its contributing factors, and potential targets for intervention through evidence-based practice.

Four-year colleges and major research universities face multiple resource constraints in providing additional material within their current curricula. One solution is using online methods to deliver additional information to students within current classes.[5] Online learning must be

designed to ensure development of critical thinking skills to be effective. Previous studies have shown that asynchronous learning networks may lead to greater collaboration and higher-level cognitive processes (ie, analysis and integration) compared to face-to-face learning environments.[6] Experiential learning is also a factor in development of critical thinking skills, as evidenced by its inclusion as a recommendation for undergraduate dietetics programs in the *Academy of Nutrition and Dietetics Council on Future Practice Visioning Report*.[7] Case-based learning that simulates real-world experiences facilitates development of knowledge and skills[8] and has been utilized in many health-related fields [9-15]; however, only limited studies in nutrition have evaluated their effectiveness.[16,17]

Several studies in nutrition have shown the potential for online learning. Wallner et al[18] developed an online continuing education course about food safety issues of high-risk populations for registered dietitians, registered dietetic technicians, nurses, and extension educators and found a significant increase in knowledge from pre-test to post-test (67.3% vs. 91.9%). Initial differences in pre-test scores based on participants' professions (ie, nurses tended to score higher than other professionals and extension educators tended to score lowest) seemed to disappear at post-test.[18] Puri et al[19] utilized computer-assisted instruction (CAI) to facilitate dietetics students' learning about nutrition counseling techniques and found a small but statistically significant increase in knowledge from pre-test to post-test for the intervention group receiving the CAI modules. Similarly, Zubas et al[20] found that a supplemental online tutorial about diabetes was effective in increasing nutrition science students' scores compared to students who only attended class lectures (10.7 ± 5.3 vs. 8.6 ± 4.5, $p = 0.04$). While these online interventions were supplemental to face-to-face lectures, other studies have reported

effectiveness of complete online courses as continuing education modules[21,22] or part of undergraduate or dietetic internship programs.[23,24]

While several studies have reported utilization, effectiveness, and satisfaction with case-based or problem-based learning in healthcare-related curricula, such as medical and nursing schools,[8,11,12,15] few studies in nutrition have reported results of either problem-based or case-based learning. Lohse et al[17] examined the effectiveness of using two problem-based learning units compared to traditional lectures in a life cycle nutrition class and found no significant differences in knowledge retention three months after the study; however, researchers found that students in the problem-based learning groups showed more evidence of critical and reflective thinking and less reliance on memorization than their lecture-based counterparts. Terry and Seibels incorporated four problem-based learning modules into an undergraduate community nutrition class and found that "course content transfer did not appear to differ significantly from the regular case study approach" but that students perceived the problem as more realistic rather than "textbook knowledge."[25] Recently, Harman et al[16] examined student learning and perception of immersive case-based learning experiences in two upper-level dietetics courses. Researchers reported that the overarching theme of "Big Picture" was articulated in focus group interviews as students appreciated using a realistic story or scenario as a method to learning problem solving skills that will be used in future professional practice. Therefore, students seemed to recognize the development of critical thinking skills through case-based learning.[16]

Researchers have also examined methods to develop collaborative care skills of students.[26,27] For example, Johnson[27] evaluated students' experiences with a collaborative health care training curriculum in which 150 students from nutrition, nursing, physical therapy, and respiratory therapy participated. The students were assigned to teams to complete case studies

and participate in simulations based on the case studies. Overall, students valued the experience as a method to develop collaborative skills for working as part of a medical care team.

The purpose of this study was to examine the impact of participating in a facilitated, scaffolded collaborative asynchronous online case-based learning module on students' knowledge about obesity prevention and treatment, as well as determine students' satisfaction with the online module experience. It was hypothesized that students would have a significant increase in score from pre-test to post-test after completing the module. It was also hypothesized that students would be satisfied with the case study module, as it simulated real-world experience.[12] Case-based learning is situated on a continuum between teacher-directed lecture-based learning and student-directed problem-based learning,[11,13] and is grounded in constructivist learning theory that views the student not as a receiver of knowledge but a co-constructor of learning through comparing new information to previous experience.[28] Students develop critical thinking skills through reflecting on what they know and what they need to know. Acquisition of knowledge is collaborative, as students construct knowledge through social interactions.[29-31] This case-based learning module was designed to facilitate students' sharing their knowledge and perspectives to engage the case study family in nutrition education and problem-solving through development of an action plan, as well as reflect on their own learning.

Methods

Study Design. This pre-test/post-test study assessed changes in knowledge about topics related to obesity management after students participated in an online collaborative case-based learning module. Content analysis of students' self-evaluation of learning essays expanded[32] understanding of students' perceived learning. A five-point Likert-scale survey assessed students' satisfaction with the module.

Module Development. The focus for the life cycle nutrition module was pediatric obesity. This upper-level course is designed for students who are not majoring in dietetics but should have completed at least the introductory nutrition course (FDNS 2100). After consulting with three faculty members integral to teaching upper-level undergraduate nutrition classes in the Department of Foods and Nutrition at the University of Georgia, the following obesity-related topics were considered important to include in this module: childhood obesity statistics and trends, obesity and risk for chronic disease, health-related complications, and impact on quality of life. The following goal and objectives were defined for the module:

Goal: Students will understand the impact of obesity across the life cycle and be able to select appropriate behavior change targets for four clients (child, adolescent, middle adult, and older adult).

- Objective 1: Students will be able to describe the impact of obesity on the immediate and future health of a child (ie, increased risk for chronic disease, obesity continuing into adulthood).
- Objective 2: Students will be able to compare how individual, family, and environmental influencers of obesity potentially change over the course of a person's life.
- Objective 3: Students will be able to assess obesity in the child and adolescent.
- Objective 4: Students will understand treatment recommendations for childhood obesity.

To introduce the framework of pediatric obesity, the case study began with a family referred to a registered dietitian nutritionist because the 5-year-old daughter had been diagnosed with obesity at her last well-child visit. The case study was designed to introduce multiple factors

for students to consider when assessing the family and designing an intervention. The child lived in a multi-generational household with both her mother and paternal grandmother, who "normalizes" the child's weight gain. Her mother was a registered nurse working 12-hour shifts at a hospital to which she commuted 45-60 minutes one-way. Her father was on a tour of duty overseas and not able to help prepare meals and promote healthy behaviors. In addition, the child lived in a neighborhood without children with whom she could play.

Module Activities. Table 4.1 summarizes the learning activities and timeline for delivery of the three-week case study module. In short, students began the module by reflecting on their own weight status as a child and their experiences with or observations of weight-based bias. Students then participated in discussion boards and group assignments designed to facilitate learning about assessing not only dietary and physical activity factors related to weight gain but also how attitudes and environmental factors contribute to a person's health. The facilitator (WB) monitored the discussion boards and provided additional questions or information as needed. Each part of the module was designed to "scaffold"[33] student's learning by providing links to appropriate, credible web sites and supplementary PowerPoint® presentations to ensure baseline knowledge, and through guiding questions to encourage critical thinking. Students completed the case study by reflecting on what they learned in the module, what they wanted to learn more about, and how they would use what they learned in practice.

Participant Recruitment. Students in a general life cycle nutrition class were invited to participate in the study through an in-class announcement by WB in Fall 2013. All students in the class were required to complete the case study module as an assignment; however, students participating in the study consented to allow materials from their case study to be analyzed and received extra credit for participating in the study. Students who did not wish to participate in the

study were given an alternative extra credit opportunity. Students provided consent to participate in the study by selecting, "Yes, I agree to participate in this study," as a response to the first question (a consent script) of the case study pre-test (Appendix B). All procedures and protocols were approved by the Human Subjects Institutional Review Board of the University of Georgia.

Module Delivery. Students were randomly assigned to groups of six by the learning management system (Blackboard®). Each part of the module (eight total), which included PowerPoint® presentations with case study information and assignment instructions, supplemental PowerPoint® presentations addressing pertinent topics, and links to external web sites, was opened at designated intervals over three weeks so that students focused on current information provided. For discussion board assignments, students were asked to post an original response to the guiding questions and respond to at least two other students. The role of facilitator (WB) was to monitor the discussion boards and provide additional guidance or questions as needed. WB posted a comment or question at least once in each group's series of discussion boards, provided feedback for assignments uploaded to the dropboxes, and responded to e-mail questions by students. WB also posted general announcements and reminders about upcoming assignments due to the "News" section of the learning management system.

Data Collection. Students completed a pre-test approximately one week before the first part of the case study opened and the same post-test approximately one week after completing the case study (Appendix G). The 30-question multiple-choice test included topics related to obesity statistics, assessment of obesity, health risks of obesity throughout the lifespan, and recommended behavioral changes. The questions were reviewed by two faculty members for clarity. The pre-test included questions about participant demographics, such as race/ethnicity, year in college, and major. Students also completed a 15-item five-point Likert-scale student

satisfaction survey (Appendix K) to assess their experiences with the online case study module. The scale asked students to indicate their level of agreement with each statement as "Strongly disagree," "Disagree," "Neither agree nor disagree," "Agree," and "Strongly agree." Finally, the self-evaluation of learning essays were collected for analysis through the assignment dropbox.

Quantitative Data Analysis. The pre-test and post-test were automatically scored by the learning management system. Individual responses to demographic questions, as well as student satisfaction survey items were recorded. All analyses were completed using SPSS v. 22 for Mac (IBM, Armonk, New York). Descriptive statistics (frequencies) for demographic data and student satisfaction survey items were completed. A paired t-test was used to determine changes in knowledge of obesity management topics from pre-test to post-test. An independent samples t-test was used to determine differences in changes in knowledge for students who scored below or above the mean on the pre-test. An independent samples t-test and one-way ANOVA were used to determine any differences in changes in score based on demographic data. Statistical significance was determined based on a two-sided p-value <0.05.

Qualitative Data Analysis. Individual self-evaluations of learning essays were uploaded to NVivo v. 10.2 for Mac (QSR International, Doncaster, Victoria, Australia). Each student's identifying information was removed and replaced with a number code. In addition, the student's intended or declared major was added to the document for coding purposes. Each essay was read in its entirety, allowing the researcher to gain a general sense of themes present in the reflections. Essays were then read for each of the learning questions (ie, what did you learn in this case study, what do you want to learn more about, and how will you use what you learned in practice?), and responses were coded using content analysis.[34]

Results

Participant characteristics. A total of 90 out of 119 students consented to participate in the study and completed both the pre-test and post-test. Two graduate students completed the case study module, but their scores were not included in analyses as the module was designed for undergraduate students. Initial analysis revealed one outlying score on the pre-test and two outlying scores on the post-test (one score was the same participant as the outlying pre-test score) using the box-plot outlier labeling rule,[35] and these scores were removed from further analyses, leaving a total of 86 participants. Participant characteristics are found in Table 4.2. Participants were 83% female and 67% were non-Hispanic white. Most students were in their third (31%) or fourth (54%) year of undergraduate education. Only 28% were majoring in Foods and Nutrition (Nutrition Science, Dietetics, Consumer Foods), with other students in Exercise and Sport Science, Health Promotion and Behavior and Human Development and Family Science. There were no significant differences in demographic characteristics between students who consented to participate in the study and those who did not (data not shown).

Change in knowledge of obesity management topics. A paired sample t-test revealed a small (10.2% ± 11.1) (percentage points) but significant change in knowledge about obesity management topics from pre-test to post-test (Table 4.3). Further analyses revealed that students who scored below the mean on the pre-test had a significantly greater change in score at post-test compared with students who had an above-mean score on the pre-test (Table 4.4). The online collaborative module appeared to close the gap in knowledge between these two groups of students. A one-way ANOVA showed that there was a significant difference in pre-test knowledge of obesity management topics based on college major, with students in Exercise and Sport Science scoring highest (Table 4.5). Interestingly, students in Foods and Nutrition scored

lowest on the pre-test but exceeded the post-test score of students in Exercise and Sport Science, also illustrating a closing of the knowledge gap for students with less baseline knowledge. Post-hoc analyses (LSD) showed a significant difference in pre-test score between Foods and Nutrition and Exercise and Sport Science and Human Development and Family Science majors but no significant difference between majors at post-test (data not shown). An independent samples t-test did not show a significant difference in pre-test, post-test, or change in scores based on gender (Table M.1), nor did one-way ANOVA analyses show significant differences based on race/ethnicity or year in college (Table M.2). Regression analyses showed that only pre-test score (-2.169, $p < 0.001$) predicted change in score from pre-test to post-test when adjusting for gender, race/ethnicity, year in college, and declared major (data not shown).

Student Satisfaction Survey. A total of 84 students completed the Student Satisfaction Survey. Cronbach alpha for the scale was 0.830, showing good reliability for the items. The majority of students agreed that the individual self-reflection raised their awareness of the values and experiences they brought to the case study (Table 4.6). Students also felt confident in their ability to address obesity in a similar situation, as well as find credible sources of information about obesity prevention and treatment. However, only two-thirds of the students agreed that creating an action plan helped them develop skills they would use in practice. Many of the students were pursuing degrees in fields outside of Foods and Nutrition, so it is likely that they did not see the application of action plans to their own careers.

While the majority of students were satisfied with the content of the case study, fewer students were satisfied with working online and in groups. Less than half of students agreed that the case study was easy to navigate in the learning management system. Students desired more time between parts of the case study, and almost half believed that the case study should be an

individual endeavor. Finally, less than one-third of students believed it was easy to work with their groups online. Many of the students expressed concern that it was too difficult to work in a group within such a large class (over 100 students), especially as they came from different majors and did not necessarily know each other.

Qualitative analysis of self-evaluation of learning. A total of 73 self-evaluation of learning essays were collected for analysis. Students were asked to identify challenges the case family was likely to face in implementing their groups' action plans, as well as issues it would be important to discuss during follow-up sessions. Table 4.7 illustrates the major themes that emerged for this topic. Over half of the students mentioned that the family faced significant time constraints in implementing their groups' action plans. They recognized that the child's mother works long hours and may not have time or energy when she returns home to prepare healthy meals or engage in active play. Students most often cited the need to plan for healthy meals and physical activity, and the need to engage all family members in supporting these changes. Most students believed that the adults in the family are role models for children, so they should engage in healthy behaviors to support the child. Many students also recognized the need to help the family hold themselves accountable for behavior change through keeping a food journal and activity log, or simply reporting changes they had made at follow-up. Finally, many students believed that if families understand the nutrition needs of children, as well as the negative health consequences of obesity, they will likely change behavior.

Students were also asked to reflect on their own learning during the case study. Specifically, they were prompted to consider what they had learned in the case study, what they would like to learn more about, and how they would use what they learned in practice. Table 4.8 shows the major themes that emerged from students' own assessment of their learning, and Table

4.9 reflects the three domains in which students planned to use what they learned in practice. Students' expression of their learning closely matched their responses to identifying the case family's challenges. For example, students recognized the role of the family in obesity prevention and treatment and that multiple factors impact health. One student expressed, "This case study taught me a great deal about the impact families have on nutrition. We often think of nutrition as simply being a personal choice, but in fact, it is influenced very significantly by your family and their habits" (Participant #2014). Students also enumerated learning practical skills, such as calculating and interpreting BMI for adults and children and creating care plans. Finally, students discussed learning about health risks associated with obesity. The majority of the themes corresponded well to the objectives of the case study, such as assessing obesity in children and adolescents, understanding how obesity impacts a child's health (obesity-related health risks), and understanding how multiple factors influence health throughout the lifespan. Students desired to learn more about early prevention of obesity, as the case study focused on a school-age child, as well as programs that are available to help families and schools. Several students also wanted to learn about caring for clients with other conditions, such as diabetes or eating disorders.

When asked how they would use what they learned in practice, students focused on three domains: personal, family, and future practice. Several students recognized that recommendations made to the case study family applied to their own habits, as well. "I am going to try making meals ahead of time like lasagna or vegetables dishes then store them for a later time when I am crammed and need a healthy meal" (Participant #2013). The majority of students also noted that they planned to ensure that their future children eat healthy and engage in physical activity, or they planned to talk about weight management strategies with family

members who were overweight. Finally, students who planned to become health care providers, in particular, planned to encourage future clients to eat healthy, be physically active, and be good role models for their families.

Discussion

Enrollment in online educational courses continues to increase in the United States. The Babson Survey Research Group, in conjunction with the College Board, has produced a series of twelve annual reports about the state of online learning in the United States. The annual survey includes information from 2,800 colleges and universities and data for 4,891 postsecondary institutions through the National Center for Education Statistics' Integrated Post-secondary Education Data System. According to the 2014 report, over five (5) million students participated in an online course in 2013, which represented an approximate 3.7% increase in online enrollment over the previous year.[36] Although this rate of increased enrollment is lower than in previous years, likely due to a change in data source used, it still represents a higher rate of increased enrollment compared to higher education in general. The majority of public and for-profit private colleges and universities offered online programs and courses in 2013.[36] As enrollment in online courses continues to increase, it will be important for faculty and administrators to develop effective strategies to facilitate learning in both online and hybrid (nearly equal online and face-to-face meetings) courses. Sandon[37] notes that online education has the capacity to meet adult learners' needs for "problem-centered learning, real-life experience, being lifelong learners, varied learning styles, a desire for learning to be meaningful and applicable to their current situation, and preferring to manage their own learning." Therefore, online education has the potential to provide students with a practical learning experience.

Results are mixed, however, regarding the effectiveness of online learning. Several studies in the health sciences have noted significant increases in knowledge with online courses or modules.[18,19,38] For example, Wallner et al[18] developed and implemented an online continuing education course to train registered dietitians, dietetic technicians registered (DTR), nurses, and extension educators about food safety issues of high-risk populations. Participants increased in score from pre-test to post-test (67.3% vs. 91.9%), which was a significant change in score.[18] Similarly, Puri et al[19] utilized online computer-assisted instruction (CAI) to facilitate dietetics students' learning about nutrition counseling techniques and found a small but statistically significant increase in knowledge from pre-test to post-test for the intervention group receiving the CAI modules. Litchfield et al[23] developed and implemented three online learning modules for their dietetic interns that included group discussions, chat room collaboration, and simulation exercises. Although the researchers did not show a significant difference in change in knowledge for two of three modules,[23] they did show a significant difference in key feature exam scores (ie, identifying a "critical step" in clinical reasoning) for students participating in the online modules compared to those who did not.[39] The researchers believed that key feature exams may provide a better indication of student's ability to transfer knowledge to practice because they focus on "critical steps" in solving a clinical problem rather than comprehension only.[23] Other studies have not found differences in change in knowledge based on participation in an online intervention.[40,41]

Similarly, results of studies examining the effectiveness of case-based or problem-based curricula or modules are mixed.[11-13] Most studies report that students appreciate the realistic nature of cases[15] and ability to simulate real-world experiences that are difficult to duplicate in class or internships.[12] There is some evidence that case-based learning or problem-based learning

increases critical thinking skills, as students tend to exhibit better clinical reasoning skills if not absolute gains in knowledge.[17,42,43] Lohse et al[17] implemented two problem-based learning modules (intervention) in a life cycle nutrition class and found no significant differences in knowledge retention after three months for students participating in the modules compared to those who were in the lecture-based group. However, the researchers found that students in the intervention group showed more evidence of critical and reflective thinking and less reliance on memorization than their lecture-based counterparts. Recently, Harman et al[16] examined student learning and perception of immersive case-based learning experiences in two upper-level dietetics courses. The researchers reported that students saw the "Big Picture" through using a realistic story or scenario as a method to learn problem-solving skills that would be used in future professional practice. Students seemed to recognize the development of critical thinking skills through case-based learning.[16]

The results of the present study are similar to previous research about effectiveness of both online and case-based learning instruction as students showed a small but significant gain in score from pre-test to post-test of 10.2%, similar to what Puri et al[19] found with students using supplemental computer-assisted modules (although they showed a gain of 0.44 points). The impact was greater for students who had scored below the mean on the pre-test (18.6% vs 3.9%, $p < 0.001$). The current study used a static form (PowerPoint® and PDF files) for presenting information to students compared to more interactive videos[19] and simulations[23] in other studies. Our similar results show that simple technology may be effective in facilitating learning. Zimmerman et al[44] examined the difference in change in score for critical thinking of allied health graduate students who participated in either interdisciplinary or single discipline case study discussion groups and found that students in the interdisciplinary group who scored below

the median on the pre-test had significantly improved scores at post-test. Students in the present study likely interacted with peers from other disciplines, as groups were randomly assigned by the learning management system. It is possible that the interaction through the discussion boards fostered learning through reading peers' perspectives. In the study by Zimmerman et al, students in the interdisciplinary group noted that the case study groups "made them think about different points of view" and "realize the importance of other's opinions."[44]

In addition, content analysis of students' self-evaluation of learning essays revealed similar themes to what Harman et al[16] found in that students noted the need to consider multiple factors in assisting a client in weight management, which is representative of the "big picture." By including the additional question about how would students use what they learned in practice, the present study potentially uncovered what students considered most important in this learning experience. The majority of students indicated that they planned to make changes to their own eating or physical activity behavior or ensure that their future children practice healthy weight management behaviors. In addition, several students planned to use their knowledge and skills in practice as health care providers or educators. These findings are similar to what Taylor et al[45] found in a nutrition class for senior dental students. At the beginning of a three-week experiential learning exercise, students were asked to select a diet-related behavior they wanted to change. Students then reported their progress and discussed key behavior change theories in relation to their efforts. In addition to being more willing to change their own behavior, dental students reported an increased intention to assist future clients in diet-related behavior change.[46] Teaching methods that encourage self-reflection may not only foster acquisition of knowledge and skills but may also encourage personal and professional behavior change. Unfortunately, the timeline

of this study did not allow for follow-up of students to determine if they did change their behavior.

There were a number of limitations in this study. First, this was a pre-test/post-test study design, so it is not possible to determine if the online collaborative case-based learning module increased knowledge more than lecture-based classes. Students were not required to meet face-to-face and could complete groups activities through online collaboration; however, several students mentioned in the student satisfaction survey free response questions that they had difficulty meeting with their group. Unfortunately, the student satisfaction survey did not include a question to determine if students met in-person to complete group assignments or not. Therefore, it is not possible to determine if online communication is at least equal to face-to-face communication. Also, it is possible that students were exposed to obesity-related information in other classes or through external channels. Therefore, gains in knowledge may not necessarily be attributable only to the online case study.

A strength of this study was that in an effort to control for outside exposure to the same information, the case study module was delivered before any discussion or lecture of pre-school and school-age pediatric nutrition or obesity in the class. Another strength of this study was collecting students' self-evaluation of learning essays. A qualitative analysis of students' perceived learning allowed for exploring complementarity[32] with what was found in the pre-test/post-test assessment of gains in knowledge. Although there was a small increase in knowledge of obesity management topics from pre-test to post-test, students explicitly articulated meeting all but one of the learning objectives for the case study (understanding treatment recommendations for childhood obesity, although students implicitly met this objective through

developing a care plan for the family). Therefore, it seems that the case study was effective in facilitating learning about obesity prevention and treatment in this setting.

Finally, students were satisfied overall with the content of the case study. The majority of students believed that group discussions helped them think about information they had not initially considered. They also felt confident in their ability to address obesity in a similar situation and find credible information about obesity prevention and treatment. However, technology and group work were sources of discontent for students. At the time, the university was transitioning to a new learning system, and some classes operated on the old platform (which was the case for this class) while some had already adopted the new platform. Students were required to login to two separate systems, which may have been burdensome for the students. In addition, many students expressed difficulty working with group members whom they did not know in a large lecture class. Although the case study was designed to be an online exercise only, students may need guidance at the beginning of the module about how to structure group work online.

Implications for Research and Practice

This online collaborative case-based learning module increased students' knowledge about obesity prevention and treatment. Overall, students were satisfied with the content of the case study and expressed intent to practice what they learned. Students also expressed a better understanding of the multi-factorial nature of obesity. However, students were less satisfied with the logistics of the online module, which may have been related to the learning management system. Future research should determine which platforms are preferred and will be used by students. For example, the case study modules could be implemented via a private Facebook group, which allows for uploading files and provides a built-in discussion board, or through a

dedicated web site that could be configured to meet students' needs. External delivery platforms would eliminate the difficulties of transitioning from one learning management system to another, which may happen frequently in universities and colleges. Future research should also include follow-up with students to determine knowledge retention and whether or not intended behavior changes are implemented or practices changed as a result of participating in the online case study. Such a follow-up study may include an online survey of obesity management knowledge (ie, the instrument used for the pre-test/post-test) to determine retention of knowledge six to twelve months post-module, as well as observations in simulated counseling sessions to determine changes in assessment and care planning behaviors. A follow-up study may also include an open-response survey assessing students' behavior changes. Finally, students expressed an interest in learning about other health conditions. Future studies should examine the effectiveness of this methodology for teaching students about clients with clinical diseases, such as diabetes, eating disorders, or renal disease.

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Table 4.1. Overview of life cycle nutrition case study module

Timeline	Activity	Objective
Week 1*		
Days 1-3	*What's Your Story?* Students reflect on their own weight as a child and how they discussed weight with their peers. Students also note if they observed exclusions due to a person's size.	Students identify their own perceptions and experiences of weight to clarify the knowledge, beliefs, and attitudes with which they approach the case study.
Days 4-6	*Perceptions of Weight* Students review a supplemental PowerPoint® presentation about weight-based stigmatization and post personal reactions to an optional group discussion board.	Students explore weight-based stigma and its implications for patient care.
Week 2		
Days 6-8	*Referral from Dr. Brown and Meeting Brianna's Family* Students review a supplemental PowerPoint® about measuring overweight and obesity to calculate Brianna's BMI-for-age percentile and classify her weight status. Students also receive general information about each of Brianna's family members and post their thoughts about additional information needed to complete a nutrition assessment, as well as potential family dynamics at play in managing Brianna's weight, to the group discussion board.	Students explore each family member's motivation to help Brianna with weight management, barriers and facilitators of behavior change, and additional information needed from each family member.
Days 8-13	*First Steps: Information* Students review a supplemental PowerPoint® about the health consequences of obesity and as a group develop an informational flyer to educate parents about the health risks of obesity and appropriate weight management strategies for children.	Students utilize creditable web sites (i.e., CDC, American Academy of Pediatrics) to present their information to parents.
Days 13-15	*Next Steps: Decision Tree* Students review a supplemental PowerPoint® about the American Academy of Pediatrics Expert Committee Recommendations for child and adolescent overweight and obesity. Students then create a decision tree as a group to guide determining appropriate treatment options for Brianna.	Students use the American Academy of Pediatrics Expert Committee recommendations to develop a decision tree to facilitate gathering additional patient information and determine appropriate level of treatment.
Week 3		
Days 15-17	*Next Steps: Assessment* Students review a supplemental PowerPoint® about family and environmental influences on obesity. Students are then divided into pairs within each group to create a PowerPoint® to present additional information received about each family member to the group.	Students examine issues that may impact Brianna's care, such as family members' health backgrounds, motivation in helping, and contribution to her care.
Days 17-22	*Final Step: Action Plan* Students integrate all information into a group action plan to help Brianna eat healthier and be more physically active. Students also consider contingency plans for the family.	Students integrate the key behaviors to focus on from the American Academy of Pediatrics into an action plan.

Timeline	Activity	Objective
Days 17-22	Final Reflection Students identify the potential barriers that the family will encounter when enacting the action plan and which issues they will likely address in follow-up sessions. Students also reflect on their own learning experience.	Student brainstorm potential barriers to carrying out the action plan and develop further contingency plans to address the barriers. Students also identify what they have learned in the case study and how they will use this knowledge in practice.

*Due to overlap of activities, weeks are approximated

Table 4.2. Characteristics of participants in a general life cycle nutrition class (N = 86)

	N (%*)
Gender	
Male	15 (17)
Female	71 (83)
Race/Ethnicity	
Asian	14 (16)
Non-Hispanic black	6 (7)
Non-Hispanic white	58 (67)
Hispanic/Other/No Response	8 (9)
Year in College	
Third-year undergraduate	27 (31)
Fourth-year undergraduate	46 (54)
Fifth-year or beyond undergraduate	13 (15)
Declared College Major	
Foods and Nutrition	24 (28)
Exercise and Sport Science	17 (20)
Health Promotion and Behavior	12 (14)
Human Development and Family Science	24 (28)
Other/Missing Data	9 (11)

*Percentages may not sum to 100 due to rounding

Table 4.3. Change in knowledge of obesity management topics in a general life cycle nutrition class after participating in an online case-based learning module

	Mean (%)	Std. Deviation	Std. Error Mean	*P*-Value
Pre-test	66.1	11.1	1.20	
Post-test	76.4	9.0	0.98	
Post-test – Pre-test	10.2	11.1	1.19	<0.001

Table 4.4. Change in knowledge of obesity management topics in a general life cycle nutrition class by pre-test score above or below the mean

	Pre-test Score* (Std. Deviation)	Post-test Score** (Std. Deviation)	Change in Score* (Std. Deviation)
Below mean pre-test score (n = 37)	55.6 (5.9)	74.1 (8.7)	18.6 (7.5)
Above mean pre-test score (n = 49)	74.1 (6.5)	78.0 (9.0)	3.9 (9.0)

All scores shown as percentages
*p <0.001 **p = 0.048

Table 4.5. Change in knowledge of obesity management topics in a general life cycle nutrition class by declared major

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Exercise and Sport Science	17	70.4 (7.3)	76.5 (7.9)	6.1 (9.8)
Health Promotion and Behavior	12	63.1 (12.3)	73.6 (11.2)	10.6 (12.3)
Human Development and Family Science	24	69.3 (9.7)	75.1 (9.0)	5.8 (10.7)
Foods and Nutrition	24	60.8 (12.2)	77.8 (9.5)	16.9 (8.2)
Other	8	67.8 (11.4)	79.3 (6.6)	11.5 (12.0)

[a]p = 0.023 [b]p = 0.55 [c]p = 0.003

Table 4.6. Satisfaction with online collaborative case-based learning module of students in a general life cycle nutrition class

	Agree N (%)	Neither agree nor disagree N (%)	Disagree N (%)
The individual self-reflection raised my awareness of the knowledge, values, and experiences I brought to the case study.	70 (83)	9 (11)	5 (6)
The group discussions helped me think about additional information I did not initially consider.	61 (73)	13 (16)	10 (12)
The "first step" and "next step" dropbox assignments helped me apply information I learned in a practical way.	46 (55)	25 (30)	13 (16)
The "first step" and "next step" dropbox assignments helped me complete the final group assignment.	53 (63)	21 (25)	10 (12)
The final group assignment helped me develop skills I would use in practice.	57 (68)	12 (14)	15 (18)
The self-evaluation helped me assess what I learned.	61 (73)	16 (19)	7 (8)
I feel confident in my skills to address obesity in a similar situation.	73 (87)	8 (10)	3 (4)
I feel confident in my skills to find credible information about obesity prevention and treatment.	75 (89)	7 (8)	2 (2)
The case study was easy to navigate on eLC.	40 (48)	22 (26)	22 (26)
The length of time between parts of the case study was adequate.	31 (37)	9 (11)	44 (52)
The variety of activities contributed to my learning.	50 (60)	21 (25)	13 (16)
It was easy to work with my online group.	24 (29)	9 (11)	51 (61)
The expectations for each part of the case study were clear.	43 (51)	19 (23)	22 (26)
Group activities contributed to my learning.	31 (37)	24 (29)	29 (35)
The case study should be an individual assignment.	39 (46)	21 (25)	24 (29)

*Percentages may not sum to 100 due to rounding

Table 4.7. General life cycle nutrition students' responses to what challenges will the family face in implementing action plan

Challenges the family will face	Follow-up topics and suggestions
Time constraints -Work schedules of mother and grandmother -Father is overseas and unavailable to help -Caregivers' involvement in other activities	***Need to plan for healthy eating and activity*** -Plan and prepare meals ahead of time -Plan time for physical activity -Pack lunch night before
Family attitudes towards weight and behavior change -Grandmother does not see child's weight as a problem -Family may have difficulty making changes -Family is used to fast-food convenience -Need to change attitude towards healthy eating and physical activity	***Accountability*** -Food journal and activity log -Ask what changes family has made -Ask how family feels about changes made
Need for physical activity -Challenge related to time constraints -Family, especially child, not used to being active -No neighborhood children with whom child can plan	***Address barriers to change*** -Determine barriers to healthy eating and physical activity if goals were not met -Suggest alternative solutions for healthy eating and physical activity -Address motivation of family members
Child resistance to change -Child may not like new healthy foods -Important for caregivers to expose child to new, healthy foods over time -Important for family to model healthy eating	***Health benefits of behavior change*** -Remind family of benefits of eating healthy and being physically active on future health of child -Discuss chronic disease associated with obesity
	Family involvement -Parents and caregivers are role models for child -Family habits impact child's habits -Importance for family members to support behavior change -All family members need to agree on and support child's behavior changes

Table 4.8. General life cycle nutrition students' responses to what did you learn in this case study, and what do you want to learn more about

What did you learn in this case study?	**What do you want to learn more about?**
Role of family in obesity prevention and treatment **-Family shapes habits** "This case study taught me a great deal about the impact families have on nutrition. We often think of nutrition as simply being a personal choice, but in fact, it is influenced very significantly by your family and their habits." – Participant #2014	***Early prevention of obesity*** "I know it can be very difficult not only to educate the families but also to get them to implement what they are being taught. It would be interesting to find out what other educators have done and what has worked in cases like this." – Participant #2013

What did you learn in this case study?	What do you want to learn more about?
-Parents should be role models of health "In this case study, I learned how important parents are as role models to their children. Since Brianna's dad was not there most of the time influencing her, Brianna did not learn from his healthy behaviors. Instead, she learned from her mother's behaviors, which unfortunately had a negative impact on her obesity." – Participant #2020 **-Need for support of family in weight management** "I have also learnt the importance of the family as a whole coming together to change their eating habits and not one person being on a diet while everyone else is eating as they like because that is not efficient. The family as a support system is very influential in changing the way children view food and eat." – Participant #2040	"After this case study, I would like to learn more about the prevention of obesity in children. I have observed how easy it can be for children to develop obesity and I would like to know more about preventing it." – Participant #2007
Multiple factors impact health **-Multiple factors affect weight** "In this case study, I learned that the weight issues of individuals usually stem from a great number of different factors, not simply eating too much, or exercising too little." – Participant #2013 **-Lifestyle factors affect weight** "In this case study, I learned how easy it can be for children to fall into obesity. Many families have very busy schedules which allows for their children to sit on the couch and watch television in the afternoons because they feel like they are not able to do other activities because of numerous limitations." – Participant #2007 **-Environmental factors affect weight** "From this case study I learned that family dynamic and environment can be a contributing factor to their children's obesity." - Participant #2050	***Programs available to address childhood obesity*** "I learned a lot about childhood obesity but I would like to learn more about it, especially about what programs are out there to help children. I am interested in seeing if schools are doing anything to help prevent childhood obesity." – Participant #2005 "I would like to learn more about what families can do to prevent it, especially in low-income neighborhoods or in families with low socioeconomic status. In the case study, we often mentioned that Brianna's family should simply prepare healthier meals for her, but that is not always easy because healthier foods are often expensive. I am interested to know what kinds of programs are available for families in this unfortunate situation." – Participant #2026
Practical skills **-Assessment of weight using BMI** "Through this assignment, I have become much more comfortable with calculation of BMI and growth charts." – Participant #2027 **-Creating care plans** "After completing this case study, I now know how important it is to take into account multiple factors, such as family history and physical activity, are to developing an effective care plan for someone who is struggling with weight." – Participant #2033	***Other health conditions*** "After the case study, I would like to know how obese can led to diabetes and asthma." – Participant #2022 "I would like to learn more about bulimia and anorexia nervosa which is a serious eating disorder problem in teenagers. Many teens hide their eating disorder and many parents don't know whether their child is suffering from bulimia or anorexia. This seems very interesting because it is the same weight problem as obesity or overweight, but it is totally different weight outcome with different age group." – Participant #2048

What did you learn in this case study?	What do you want to learn more about?
-Nutrition assessment "You need to consider their current health, physical activity, eating patterns, their parent's current health, physical activity, eating patterns, the health history of past family members. It is just a lot that needs to be evaluated in order to create a care plan for your life!" – Participant #2046 -Health risks of obesity "I have learned that obesity can cause many problems in children and it will carry onto adulthood. Obesity increased risk for developing asthma, diabetes, high blood pressure, high cholesterol, sleep apnea, and many other risks. I have learned that it is very important to help the children stay healthy because they are the future of the family." – Participant #2022	

Table 4.9. General life cycle nutrition students' responses to how will you use what you learned in practice

Personal	Family	Practice
"I will limit the juice intake in my diet." – Participant #2001 "I think the main thing I will take away is that there are easy ways to incorporate healthy eating habits and physical activity into my busy, everyday life and these habits can have really beneficial long term effect on my health." - Participant #2011 "Although I am at a healthy weight and exercise my food choices are still very important. I am going to try making meals ahead of time like lasagna or vegetable dishes then store them for a later time when I am crammed and need a healthy meal." - Participant #2013	"In the future, I plan to encourage my mother to cook healthy family meals when possible. She works at a middle school, so I am also going to encourage her to persuade her students to get outside and away from computer or television screens." – Participant #2026 "I will use what I learned from this case study to help children in my family and my future children stay healthy." – Participant #2041	"I will use what I learned in this case study with my future dealings with children and families. I may not always have to take a person's BMI, but I can always encourage families to practice better nutrition habits." – Participant #2005 "I plan on one day becoming a nurse, and I will use this information when working with young children and their parents, by encouraging the parents to model a healthy lifestyle for their children." – Participant #2018

CHAPTER 5

A VARIETY OF STAKEHOLDERS: STUDENTS EXPLORE SCHOOL WELLNESS POLICIES THROUGH ONLINE CASE STUDY MODULE[1]

[1]Bignell, W.E. and J.G. Fischer. To be submitted to *Journal of Nutrition Education and Behavior*.

Abstract

Objective: To determine changes in students' knowledge about community, environmental, and school strategies to prevent obesity and students' satisfaction after participating in an online collaborative case-based learning (CBL) module.

Design: Online pre-test/post-test study design, student satisfaction survey, and content analysis of students' self-evaluation of learning essays.

Setting: Community nutrition class at a large research university.

Participants: A convenience sample of 39 students enrolled in a community nutrition class.

Intervention(s): Students participated in an online CBL module with information about school wellness policies delivered incrementally over three weeks. Students were randomized to groups of 5-6 and participated in discussion boards and online group activities.

Variables Measured: Change in knowledge about community-level (ie, environmental and school) factors and strategies to prevent obesity, students' satisfaction and perceived learning.

Analysis: Paired t-test, t-test, one-way ANOVA (significance $p < 0.05$), frequencies, content analysis of essays.

Results: Students increased knowledge of community-level factors and strategies to prevent obesity by 2.0% (percentage points), although this change was not statistically significant. Students acknowledged the stakeholder's role in policy change in their self-evaluation of learning essays.

Conclusions and Implications: An online CBL module increased students' appreciation of the role of stakeholders in policy change.

Keywords: online nutrition education, case-based learning, community nutrition, dietetic education, college students

Introduction

Over 35% of adults and 17% of children and adolescents in the United States are considered obese.[1] Because of its association with multiple chronic diseases[2] and increased health care costs,[3] obesity continues to be considered a major public health issues. Obesity prevention and treatment are challenging due to the multi-factorial nature of the disease, as many individual, family, community, and environmental factors impact weight.[4] Effective interventions rely on not only healthcare providers but also the general population to support behavioral changes within their families and communities. Indeed, community efforts play a key role in obesity prevention and treatment, as the Centers for Disease Control and Prevention (CDC) provide numerous resources related to both community-based[5] and school-based[6] strategies to promote a healthy lifestyle. To effect change, current undergraduate students in all majors, who will become the next generation of healthcare providers, teachers, parents, policy makers, business leaders, and community advocates, should understand health risks associated with obesity and be prepared to advocate for community changes to support a healthy weight. Therefore, undergraduate nutrition programs should include an overview of obesity prevention and treatment, with an emphasis on the multi-factorial, multi-level nature of this disease and effective strategies to combat it.

However, undergraduate programs face a number of challenges related to time and budget constraints to provide such a comprehensive overview of obesity prevention and treatment within current curricula. Online learning may provide a solution to these challenges. Online learning must be designed to ensure development of critical thinking skills to be effective. Previous studies have shown that asynchronous learning networks may lead to greater collaboration and higher-level cognitive processes (ie, analysis and integration) compared to

face-to-face learning environments,[7] which are important skills in advocating for community change and working with a variety of stakeholders. Experiential learning is also a factor in development of critical thinking skills and collaboration.[8,9] Compared to lecture-based learning, which places the learner in a passive role and requires effort outside of class to develop understanding and retention of knowledge,[10] case-based learning simulates real-world experience to facilitate development of knowledge and skills[11] and has been utilized in many health-related fields,[12-18] with a limited number of studies in nutrition. Several studies have shown online learning to be effective in increasing students' knowledge[19-21] but have shown mixed results for problem-based learning or case-based learning,[22-24] although students appreciate the realistic nature of the cases. No studies combining case-based learning and an online format in nutrition were found.

The purpose of this study was to examine the impact of participating in a collaborative online case-based learning module in a community nutrition course on students' knowledge about the role of policy and the built environment in obesity prevention and treatment. The study also aimed to determine students' satisfaction with the online module experience. It was hypothesized that students would have a significant increase in score from pre-test to post-test after completing the module. It was also hypothesized that students would be satisfied with the case study module, as it simulated real-world experience[15] and provided additional practice to prepare them for the community needs assessment project in class. Case-based learning is grounded in constructivist learning theory that views the student not as a receiver of knowledge but a co-constructor of learning through comparing new information to previous experiences.[25] Students develop critical thinking skills through reflecting on what they know and what they need to know, and knowledge acquisition is collaborative, as students construct knowledge

through social interactions.[26-28] This case-based learning module was designed to facilitate students' sharing their knowledge and perspectives to engage stakeholders in the process of updating and implementing a school wellness policy.

Methods

Study Design. This pre-test/post-test study assessed changes in knowledge of community, environmental, and school strategies to prevent obesity after students participated in an online collaborative case-based learning module. Content analysis of students' self-evaluation of learning essays expanded[29] understanding of students' perceived learning of community-level strategies to prevent obesity. A five-point Likert-scale survey assessed students' satisfaction with the module.

Module Development. To facilitate exploration of environmental and policy factors impacting health, the focus of the case study module for the community nutrition course was school nutrition and wellness policies. This upper-level course is required for dietetics students and serves and an elective for students majoring in nutrition science, health promotion and behavior, and other subjects. A team of three faculty experts who teach undergraduate nutrition courses in the Department of Foods and Nutrition at the University of Georgia determined that key topics relevant to this course included obesity statistics and trends, Dietary Guidelines for Americans, community assessment, the role of policy in preventing obesity, and community/school-level factors associated with obesity. The framework for the case study was an assessment of an elementary school environment followed by planning for and development of a revised school wellness policy.

The following were the goal and objectives of the case study:

Goal: Students will understand the environmental and policy factors that contribute to obesity and be able to advocate for changes at both the micro- and macro-environmental levels.

Objective 1: Students will be able to identify community and school environmental factors that contribute to obesity and propose interventions to address these factors.

Objective 2: Students will understand the use of policy in the fight against obesity and discuss the benefits and costs associated with various proposals.

The case study allowed students to understand community influences on health. During the case study, students explored identification of key stakeholders, information required to introduce the need for revising the school wellness policy, planning for an assessment of the school wellness environment, and development of a wellness policy. Activities, topics, and objectives for each section of the case study are listed below (Table 5.1). Each part of the module was designed to "scaffold"[30] student's learning by providing links to appropriate, credible web sites and supplementary PowerPoint® presentations to ensure baseline knowledge, and through guiding questions to encourage critical thinking.

Participant Recruitment. Students in an upper-level community nutrition course (FDNS 4540) were invited to participate in the study through an in-class announcement by the co-principal investigator (WB) in Spring 2014. All students in the class were required to complete the case study module as an assignment; however, students participating in the study consented to allow materials from their case study to be analyzed and received extra credit for participating in the study. Students who did not wish to participate in the study were given an alternative extra credit opportunity. Students provided consent to participate in the study by selecting, "Yes, I

agree to participate in this study," as a response to the first question (a consent script) of the online case study pre-test (Appendix B). All procedures and protocols were approved by the Human Subjects Institutional Review Board of the University of Georgia.

Module Delivery. Students were randomly assigned to groups of six by the learning management system (Desire2Learn®). Each part of the module (nine total), which included PowerPoint® presentations with case study information and assignment instructions, supplemental PowerPoint® presentations addressing pertinent topics, and links to external web sites, were opened at designated intervals over approximately three weeks so that students focused on current information provided. For discussion board assignments, students were asked to post an original response to the guiding questions and respond to at least two other students. WB monitored the discussion boards and provided additional guidance or questions as needed. WB posted a comment or question at least once in each group's series of discussion boards, provided feedback for assignments uploaded to the dropboxes, and responded to e-mail questions by students. WB also posted general announcements and reminders about upcoming assignments due to the "News" section of the learning management system. Group and individual assignments were uploaded to the learning management system.

Data Collection. Students completed a pre-test approximately one week before the first part of the case study opened and the same post-test approximately one week after completing the case study (Appendix H). The 19-question multiple choice and short-answer test included topics related to environmental factors associated with obesity, school factors related to healthy and unhealthy eating and physical activity behaviors, and community policies associated with obesity prevention. The questions were reviewed by two faculty members for clarity. The pre-test included questions about participant demographics, such as race/ethnicity, year in college,

and major. Students also completed a 15-item five-point Likert-scale student satisfaction survey (Appendix K) to assess their experiences with the online case study module. The scale asked students to indicate their level of agreement with each statement as "Strongly disagree," "Disagree," "Neither agree nor disagree," "Agree," and "Strongly agree." Finally, the self-evaluation of learning essays were collected for analysis.

Quantitative Data Analysis. Multiple-choice questions on the pre-test and post-test were automatically scored by the learning management system. Short answer questions were scored (quanticized) by an independent graduate student based on a rubric developed by WB, who then reviewed the scores in the learning management system for consistency and adjusted if necessary (ie, the score was not saved in the system). Individual scores for each question as well as individual responses to demographic and student satisfaction survey questions were collected. Pre-test and post-test scores, descriptive statistics (frequencies) for demographic data and student satisfaction survey items were calculated with SPSS v. 22 for Mac (IBM, Armonk, New York). A paired t-test was used to determine changes in knowledge of community-level factors and strategies to prevent obesity from pre-test to post test. Paired t-tests were also used to determine changes in score for each question to identify topics with which students were already familiar or problematic questions. An independent samples t-test was used to determine differences in changes in knowledge of community-level factors and strategies to prevent obesity for students who scored below or above the mean on the pre-test. An independent samples t-test and one-way ANOVA were used to determine any differences in changes in knowledge based on demographic characteristics.

Qualitative Data Analysis. Individual self-evaluation of learning essays were uploaded to NVivo v. 10.2 for Mac (QSR International, Doncaster, Victoria, Australia). Each student's

identifying information was removed and replaced with a number code. Each essay was read in its entirety, allowing the researcher to gain a general sense of themes present in the reflections. Essays were then read for each of the learning questions (ie, what did you learn in this case study, what do you want to learn more about, and how will you use what you learned in practice?), and responses were coded using content analysis[31]

Results

Participant characteristics. A total of 39 out of 41 students consented to participate in the study and were included in analyses. One participant's scores were excluded from analyses because the post-test score was considered an outlier using the box-graph outlier-labeling rule.[32] The majority of students were female (92%) and fourth-year undergraduates (72%; Table 5.2). Almost half of the students (49%) had participated in a similar online collaborative case-based learning module during the Fall 2013 semester. Only one student did not elect to participate in the study after completing the pre-test late; however, no reason was given for submitting the alternative extra credit assignment.

Changes in Knowledge. A paired t-test showed that students increased their knowledge of community-level factors and strategies to prevent obesity by 2.1% (percentage points) (65.0% ± 10.5 vs. 67.1% ± 10.8) from pre-test to post-test (Table N.2); however, the difference was not statistically significant. When comparing scores on multiple-choice questions only, students showed a 3.5% (percentage points) increase (65.6% ± 9.7 vs. 69.1% ± 10.2) in score from pre-test to post-test, which trended towards significance ($p = 0.051$) (Table 5.3). For most of the open-response questions, students had the opportunity for partial credit. At post-test, a greater percentage of students received full credit for listing environmental factors related to need to ride to school, community programs to increase purchase of fruits and vegetables, barriers to physical

activity in rural areas, and strategies to ensure that wellness policies are implemented (Table N.1). However, fewer students listed a low-cost option for encouraging walking to school at post-test (54% vs. 39%, p = 0.083). The most frequently cited suggestions from students were installing sidewalks or cross-walks. While these suggestions are viable options, they are not low-cost. It is possible that students ignored the qualifier "low-cost," especially after exposure to information about community-level strategies to encourage physical activity, such as ensuring access to pedestrian-friendly roads.

A surprising finding was that fewer students correctly identified the criteria for school lunch program meals at post-test (56% vs. 39%, p = 0.051). Students may have misunderstood the statement, "Offer only low-fat flavored milk," interpreting it as only low-fat flavored milk should be offered as opposed to whole flavored milk. However, this interpretation is not correct, as only fat-free flavored milk should be offered, but low-fat unflavored milk may be offered.[33]

A t-test and ANOVA indicated that gender (Table N.3) and race/ethnicity (Table N.4) had no effect on change in knowledge of community-level factors and strategies to prevent obesity, although scores at pre-test and post-test were significantly different based on race/ethnicity. There also were no differences in change in knowledge based on participants' classroom characteristics of scoring below versus above the mean on the pre-test (Table N.5) or having previously participated in an online case study module (Table N.6). There was a significant difference in change in knowledge from pre-test to post-test based on both year in college (Table 5.4) and declared major (Table 5.5). However, regression analyses showed that only pre-test score (-1.35, p = 0.028) predicted change in knowledge of community-level factors and strategies to prevent obesity when adjusting for gender, race/ethnicity, year in college, and declared major.

Student satisfaction. Overall, students were satisfied with the content of the online case study (Table 5.6). Cronbach-alpha for the scale was 0.22, indicating that it may not be a good measure of satisfaction. The majority of students agreed or strongly agreed that the self-reflection raised awareness of previous knowledge, beliefs, and experience; group discussion boards helped them think about additional information they did not initially consider; they feel confident in their ability to address obesity in a similar situation; and they feel confident in their skills to find credible information about obesity prevention and treatment. However, students were less satisfied with the logistics of the online case study. Less than half of students agreed or strongly agreed that the case study was easy to navigate in the learning management system and that the length of time between parts of the case study was adequate. However, most students felt that it was easy to work with their online group and that group activities contributed to their learning. Less than half of the students believed that the case study should be an individual assignment. The majority of students cited discussion boards or reading other students' responses to prompts as aids in their learning (data not shown), so they seemed to appreciate the benefits of group work.

Students' perception of learning (qualitative analysis). Figure 5.1 illustrates the major themes that emerged from students' self-evaluation of learning essays. The majority of students recognized the role of stakeholders in implementing a wellness policy. Engaging a variety of stakeholders, assessing their needs, and gaining buy-in were key issues discussed by students.

> "This case study taught me that sometimes it is better to include as many people as possible when trying to develop a new policy. Instead of just using the minds of those key stakeholders and school officials, getting the parents, community leaders, and even

students involved leads to a greater number of ideas, as well as being able to interpret what the community feels is most important to focus on." (Participant #213893)

Students also articulated the need to continually raise awareness about and evaluate implementation of the new school wellness policy. Without adequate communication, and without holding key faculty and staff accountable for implementation, the wellness policy would not be effective.

> "The new wellness policy needs to be implemented in schools better. Elected officials, teachers and parents all need to encourage students to follow the new guidelines better and set an example for them also. The policy needs to be more seen around the community, in local stores, the radio and on TV." (Participant #220396)
>
> "To ensure the new wellness policy is not 'put in the filing cabinet to collect dust', I would send out evaluations to the teachers, administrators and food service staff to see how things coming along with the wellness policy. From there I can assess what is being put to use and what is not. If there are parts of the wellness policy that aren't being used, I would probably have a discussion group or have input from each person who completed the evaluations, to ask why certain parts of the wellness policy are not being put to use." (Participant #215576)

Finally, several students expressed intent to become an advocate for wellness in their own communities.

> "Beyond college I plan on using the information I learned to try and make an impact in my own community. I will certainly pay much more attention to what is going on in my community." (Participant #240660)

> "Personally, I would like to know more about other successful programs similar to our staged endeavor. We learned about one particular success story, which sparked my own fire into considering community involvement, but I would like to hear more . . . I can take what I have learned from this case study and implement it into my own ideas once I have become established in my choice career path." (Participant #215646)

Overall, students expressed learning about a key step in policy change – engaging stakeholders. Students also understood that policy implementation requires strategies for communicating the policy to all who are affected by the policy and continuous evaluation to ensure that the policy is enforced. Finally, many students intended to advocate for school wellness policies in their careers or as parents.

Discussion

Online delivery of course material may allow undergraduate programs in nutrition and other disciplines to include additional topics within current curricula. In addition, online learning may be an effective medium of learning for adults. Sandon[34] notes that online education has the capacity to meet adult learners' needs for "problem-centered learning, real-life experience, being lifelong learners, varied learning styles, a desire for learning to be meaningful and applicable to their current situation, and preferring to manage their own learning." However, results are mixed regarding the effectiveness of online learning. Several studies in the health sciences have noted significant increases in knowledge with online courses or modules.[19,35-37] For example, Wallner et al[36] developed and implemented an online continuing education course to train registered dietitians, dietetic technicians registered, nurses, and extension educators about food safety issues of high-risk populations. Participants increased in score from pre-test to post-test (67.3% vs. 91.9%), which was a significant change in score.[36] Francis et al[37] examined differences in

class score for students enrolled in online versus face-to-face versions of a didactic program in dietetics and found that students the online program performed as well or better than their face-to-face peers. Litchfield et al[38] developed and implemented three online learning modules for their dietetic interns that included group discussions, chat room collaboration, and simulation exercises. Although the researchers did not show a significant difference in change in knowledge for two of three modules,[38] they did show a significant difference in key feature (ie, critical step in clinical reasoning) exam scores for students participating in the online modules compared to those who did not.[20] The researchers believed that key feature exams may provide a better indication of student's ability to transfer knowledge to practice because they focus on "critical steps" in solving a clinical problem rather than comprehension only.[38] Other studies have not found differences in change in knowledge based on participation in an online intervention.[39,40]

Results of studies examining the effectiveness of case-based or problem-based curricula or modules are mixed.[14-16] Most studies report that students appreciate the realistic nature of cases[18,23] and ability to simulate real-world experiences that are difficult to duplicate in class or internships.[15] For example, Terry and Seibels[23] implemented four problem-based learning modules in an undergraduate community nutrition class and found that "course content transfer did not differ significantly from the regular case study approach" but students perceived the problems as real rather than "textbook knowledge." There is some evidence that case-based learning or problem-based learning increases critical thinking skills, as students tend to exhibit better clinical reasoning skills if not absolute gains in knowledge.[22,41,42] Lohse et al[22] implemented two problem-based learning modules (intervention) in a life cycle nutrition class and found no significant differences in knowledge retention after three months for students participating in the modules compared to those who were in the lecture-based group. However,

the researchers found that students in the intervention group showed more evidence of critical and reflective thinking and less reliance on memorization than their lecture-based counterparts. Recently, Harman et al[24] examined student learning and perception of immersive case-based learning experiences in two upper-level dietetics courses. The researchers reported that students saw the "Big Picture" through using a realistic story or scenario as a method to learn problem-solving skills that would be used in future professional practice. Students seemed to recognize the development of critical thinking skills through case-based learning.[24]

The present study expands on previous research by combining online educational methods and case-based learning. There was a small but non-significant change in score from pre-test to post-test, which is consistent with previous studies.[14-16] However, students expressed understanding the need to engage a variety of stakeholders in the policy development and implementation process, communicating new policies with those affected by them, and the need to evaluate the effectiveness of policies and update as needed, which are key to the policy-making process. Many students also intended to advocate for wellness policies in their own communities, which may indicate that they were engaged with the content of the module and saw application to their own lives.

Overall, students were satisfied with the module despite difficulties navigating the learning management system. Previous studies have indicated that students appreciate case-based learning because it simulates real life.[15,16] Interestingly, students appreciated the group component of the modules, as 85% agreed or strongly agreed that groups discussions helped them consider additional information, and 69% agreed that group activities contributed to their learning. In the self-evaluation of learning essays, a few students noted that they appreciated the need for a team and had learned how to effectively work in a group (data not shown). This

module was designed to simulate, on a smaller scale, the major project in the public health dietetics class, which is a community needs assessment. Students were already engaged in the community assessment and may have seen application of this online module to their project. In addition, upper-level students in foods and nutrition courses in our department have several group projects, so these students may have been more adept at facilitating group work.

There were limitations in the present study. For example, this was a pre-test/post-test study design. Because there was no control group, it was not possible to determine if the online collaborative case-based learning module was more effective than lectures. In addition, students were exposed to lectures about public policy, advocacy, and school nutrition prior to the start of the case study. Therefore, the module was supplemental to what students had learned in class, and it was not possible to separate the effects of the module from the effects of the lectures. However, Zubas et al[21] tested the effectiveness of supplemental online tutorials about diabetes and found that there was a significant increase in score from pre-test to post-test (10.7 ± 5.3 vs. 8.6 ± 4.5, $p < 0.05$) for students who received the tutorial compared to those who only attended lectures. So, it is possible that the current module augmented students' knowledge about policy development.

A strength of this study was the collection of students' perceived learning. Analyses of students' reflections revealed that students learned about the importance of engaging a variety of stakeholders in wellness policy development. In addition, several students expressed intent to become more involved in their own communities. The module may have facilitated transferring what was learned in theory (ie, policy development) to applying it in practice (ie, intent to advocate for wellness policies).

Implications for Research and Practice

Although this online collaborative case-based learning module did not significantly increase students' knowledge about obesity prevention and treatment in the community setting, students were satisfied with the content of the case study and expressed intent to advocate for wellness policies in their own communities. Students articulated appreciating the importance of engaging multiple stakeholders in policy development, as well as the need to communicate the new policy to those affected by it. Students also recognized the need to regularly evaluate enforcement of the policy in order to hold everyone accountable. Unfortunately, the study timeline did not permit follow-up with students to determine how they used knowledge and skills gained in this module in practice, if at all. Future research should include follow-up with students to determine knowledge retention and whether or not intended behavior changes are implemented or practices changed as a result of participating in the online case study. Future studies should also examine the effectiveness of this methodology for teaching students about other community health-related topics, such as grant-writing or public health leadership.

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Table 5.1 Timeline of online case study activities in a community nutrition course

Timeline	Activity	Objective
Week 1*		
Days 1-3	*What's Your Story?* Students reflect on their own experience of eating healthy and being physically active in elementary and middle school.	Students explore facilitators and barriers to healthy eating and physical activity they experienced in the K-8 setting.
Days 3-8	*Helping Brianna: A Community Perspective* Students receive initial information about Brianna's school and review a supplemental PowerPoint® presentation about updates to school wellness policy requirements. Students determine key stakeholders to involve, as well as information to collect, to begin the process of revising the school wellness policy through discussion board postings.	Students define stakeholders and determine information needs to revise school wellness policy.
Week 2		
Days 5-10	*Engaging the Stakeholders* Students review a supplemental PowerPoint® about updates to the school meal requirements, as well as the CDC's resources for school wellness policies in order to develop a group PowerPoint® to persuade stakeholders to engage in revising the school wellness policy.	Students develop a persuasive argument to motivate stakeholders to take on the project of revising and implementing the school wellness policy.
Days 10-15	*Initial Assessment* Students review the CDC's School Health Guidelines to Promote Healthy Eating and Physical Activity and post their thoughts about key behaviors, environmental factors, and school policies to assess to the group discussion board.	Students determine three key behaviors, environmental factors, and school policies to assess as part of revising the school wellness policy.
Days 12-17	*Key Issues to Address* Students review the results from the brief school assessment and post their thoughts about the three most important issues to address in the revised school wellness policy.	Students prioritize issues that can and should be addressed by the revised wellness policy.
Days 12-17	*Planning for Action* Students review a supplement PowerPoint® about the CDC's 24 Community Strategies to Prevent Obesity and the CDC's School Health Index to plan for a full assessment of the school.	Students outline a full assessment of the school environment, including components to assess, who will be involved, and when/how to report findings.
Week 3		
Days 17-19	*A Model Example* Students review a video about a teacher in California who included healthy eating and physical activity practices in her classroom. Students post their thoughts about the parents' and students' reactions to these activities, as well as how this model could influence their own wellness policy, to the group discussion board.	Students discuss the behaviors incorporated in the teacher's classroom, noting parents' and students' responses, and how the video may influence the wellness policy.

Timeline	Activity	Objective
Days 17-23	*Putting It All Together* Students develop a group 1-3 page school wellness policy, linking recommendations to the Dietary Guidelines for Americans and Physical Activity Guidelines for Americans, as well as best practices in school wellness. Students also provide for staff training.	Students develop a school wellness policy based on the needs of the school.
Days 17-25	*Final Reflection* Students articulate strategies to ensure implementation of the school wellness policy, as well as identify ways to scale up recommendations to the community at-large. Students also reflect on what they learned in the case study, what they want to further explore, and how they will use what they learned in practice.	Students reflect on how to ensure that the school wellness policy is successfully implemented and that all stakeholders are aware of the policy. Students also reflect on their own learning in the case study.

*Due to overlap of activities, weeks are approximated

Table 5.2. Characteristics of participants in a community nutrition class

	N (%)*
Gender	
Male	3 (8)
Female	36 (92)
Race/Ethnicity	
Asian	14 (36)
Non-Hispanic Black	2 (5)
Non-Hispanic White	21 (54)
Hispanic	1 (3)
Other/Prefer Not to Answer	1 (3)
Intended or Declared Major	
Nutrition Science	15 (39)
Dietetics	21 (54)
Biology	3 (8)
Year in College (Undergraduate)	
Third-year	6 (15)
Fourth-year	28 (72)
Fifth-year or beyond	5 (13)
Previously Participated in Online Module	
Yes	19 (49)
No	20 (51)

*Percentages may not sum to 100 due to rounding

Table 5.3. Change in knowledge of community-level factors and strategies to prevent obesity in a community nutrition class after participating in an online collaborative CBL module (Multiple Choice)

	n	Mean	Std. Deviation	Std. Error Mean	*P*-Value
Pre-test	39	65.6	9.7	1.56	0.051
Post-test	39	69.1	10.2	1.63	

Table 5.4. Change in knowledge of community-level factors and strategies to prevent obesity in a community nutrition class by year in college

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Third-year undergraduate	6	62.2 (9.8)	72.2 (11.9)	10.0 (13.3)
Fourth-year undergraduate	28	73.3 (7.8)	73.2 (8.5)	-0.1 (7.0)
Fifth-year or beyond undergraduate	5	66.7 (8.2)	71.3 (9.6)	4.7 (8.0)

[a]p = 0.009 [b]p = 0.90 [c]p = 0.028

Table 5.5. Change in knowledge about community-level factors and strategies to prevent obesity in a community nutrition class by declared major

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Nutrition Science	15	67.1 (10.8)	74.0 (9.1)	6.9 (9.9)
Dietetics	21	73.3 (7.1)	71.6 (9.0)	-1.7 (6.9)
Biology	3	71.1 (8.4)	75.6 (9.6)	4.4 (3.8)

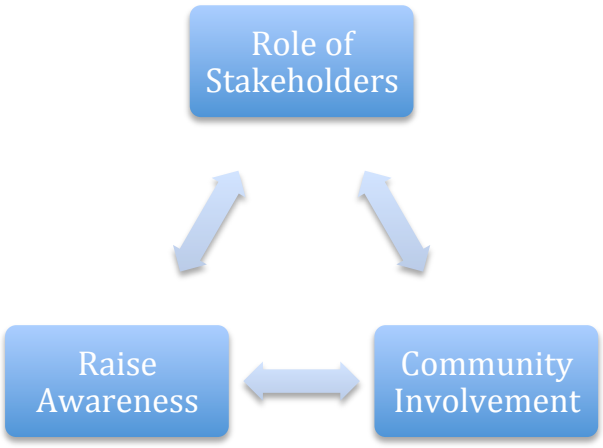
[a]p = 0.12 [b]p = 0.64 [c]p = 0.011

Table 5.6. Satisfaction with online collaborative case-based learning module of students in a community nutrition class (N = 38*)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Between Responses Indicated
The individual self-reflection raised my awareness of the knowledge, values, and experiences I brought to the case study.	0% (0)	3% (1)	3% (1)	71% (27)	24% (9)	0% (0)
The group discussions helped me think about additional information I did not initially consider.	0% (0)	3% (1)	11% (4)	40% (15)	45% (17)	3% (1)
The "first step" and "next step" dropbox assignments helped me apply information I learned in a practical way.	0% (0)	0% (0)	16% (6)	74% (28)	5% (2)	5% (2)
The "first step" and "next step" dropbox assignments helped me complete the final group assignment.	0% (0)	3% (1)	11% (4)	61% (23)	21% (8)	5% (2)
The final group assignment helped me develop skills I would use in practice.	0% (0)	3% (1)	21% (8)	53% (20)	21% (8)	3% (1)
The self-evaluation helped me assess what I learned.	0% (0)	5% (2)	16% (6)	58% (22)	21% (8)	0% (0)
I feel confident in my skills to address obesity in a similar situation.	0% (0)	0% (0)	11% (4)	76% (29)	11% (4)	3% (1)
I feel confident in my skills to find credible information about obesity prevention and treatment.	0% (0)	0% (0)	8% (3)	63% (24)	29% (11)	0% (0)
The case study was easy to navigate on eLC.	5% (2)	26% (10)	26% (10)	26% (10)	5% (2)	11% (4)
The length of time between parts of the case study was adequate.	8% (3)	24% (9)	21% (8)	42% (16)	3% (1)	3% (1)
The variety of activities contributed to my learning.	0% (0)	8% (3)	16% (6)	66% (25)	11% (4)	0% (0)
It was easy to work with my online group.	8% (3)	18% (7)	11% (4)	45% (17)	18% (7)	0% (0)
The expectations for each part of the case study were clear.	0% (0)	3% (1)	11% (4)	71% (27)	16% (6)	0% (0)
Group activities contributed to my learning.	3% (1)	11% (4)	18% (7)	58% (22)	11% (4)	0% (0)
The case study should be an individual assignment.	13% (5)	42% (16)	18% (7)	16% (6)	11% (4)	0% (0)

*Percentages may not sum to 100 due to rounding

Figure 5.1. Students' perception of learning about community-level factors and strategies to prevent obesity in an online collaborative CBL module in a community nutrition class



CHAPTER 6

IMPACT OF ONLINE COLLABORATIVE CASE STUDY MODULES ON STUDENTS' OBESITY MANAGEMENT SKILLS IN TWO DIETETICS COURSES[1]

[1]Bignell, W.E. and J.G. Fischer. To be submitted to *Journal of the Academy of Nutrition and Dietetics*.

Abstract

Background. Undergraduate didactic programs must explore innovative methods for providing experiential learning opportunities within the confines of current budgetary and schedule constraints.

Objective. Our aim was to test the impact of an online collaborative case-based learning module on students' obesity management knowledge and skills.

Design. This was a pre-test/post-test study design in which students completed either an online module or equivalent paper case study during the first semester and the alternative format the following semester. Pre-test/post-test, student satisfaction survey, focus group interviews, and self-reflection of learning essays were collected.

Participants/setting. Students in two senior-level dietetics courses at a large university were invited to participate in the study during Fall 2013 and Spring 2014 semesters. A total of 44 students were included in analyses.

Intervention. Students completed either an online collaborative case study module or paper-based case study about obesity management in Fall 2013; students then completed the alternative format the following semester.

Main outcome measures. Change in knowledge of obesity management and student satisfaction with the learning experience were outcome measures of interest. It was hypothesized that students in the online module would have greater change in knowledge of obesity management compared to their peers in the paper-based modules.

Statistical analyses performed. χ^2 analysis, paired t-tests, t-tests, ANOVA, and ANCOVA were used to determine differences in changes in knowledge of obesity management. Content analysis of reflective essays and focus group interviews were also used.

Results. There was a trend toward significant increases in knowledge of obesity management based on participation in the online group (6.5% vs. -0.6%, $p = 0.050$) in the first semester but not the second semester. Overall, students were satisfied with the learning modules. Students expressed learning about the nutrition care process and nutrition counseling in the module.

Conclusions. Online case-based learning modules may or may not increase knowledge but provide a satisfying experiential learning experience for students.

Keywords: dietetics education, obesity management, case-based learning, online education, college students

Introduction

Obesity continues to be a major public health concern in the United States, with approximately 35% of adults and 17% of children and adolescents considered obese.[1] Healthcare providers are uniquely positioned to address obesity in practice, as patients are often responsive to their physicians' or other providers' recommendations.[2] However, many physicians may not feel adequately prepared to counsel patients about obesity.[3] Registered dietitian nutritionists (RDN) occupy a unique role on the interdisciplinary weight management team by employing the nutrition care process[4] to assess clients and determine nutrition diagnoses to prioritize interventions and monitor and evaluate indicators and outcomes.[5] The RDN is able to not only compare usual dietary intake and physical activity to appropriate reference standards but also assess readiness to change, identify barriers to changing behaviors, and develop and implement effective evidence-based nutrition education and counseling interventions to promote weight management in individual, group, and worksite settings.[5] Therefore, training in undergraduate and dietetic internship programs is essential to prepare students to practice these skills in an interdisciplinary setting,[6] and multiple opportunities to develop skills in the nutrition care process through experiential learning are warranted.[7]

Four-year colleges and major research universities face multiple resource constraints in providing additional material within their current curricula. One solution is using online methods to deliver additional information to students within current classes. There is increased support for universities offering more classes and even degree programs online in an effort to reach more potential students.[8] Online learning must be designed to ensure development of critical thinking skills to be effective. Previous studies have shown that asynchronous learning networks may lead to greater collaboration and higher-level cognitive processes (ie, analysis and integration)

compared to face-to-face learning environments.[9] Experiential learning is also a factor in development of critical thinking skills, as evidenced by its inclusion as a recommendation for undergraduate dietetics programs in the *Academy of Nutrition and Dietetics Council on Future Practice Visioning Report*.[7] Case-based learning that simulates real-world experiences facilitates development of knowledge and skills[10] and has been utilized in many health-related fields[11-17]; however, a limited number of studies have evaluated their effectiveness in the field of dietetics.[18,19]

Studies in nutrition and dietetics have reported favorable results for online continuing education modules,[20-22] modules intended to supplement face-to-face lectures,[23,24] and complete online courses for didactic and internship programs,[25-27] showing that online learning is at least as effective, if not better, than face-to-face classes. Studies examining case-based or problem-based learning have shown mixed results,[18,19,28] although most report students' positive learning experiences with the "realistic" nature of the cases. Other studies have shown that collaboration is effective in education, as well.[29,30] However, no studies combining online, collaborative, and case-based or problem-based learning in nutrition were found.

The purpose of this study was to compare the effectiveness of participating in a guided online collaborative, scaffolded, case-based learning module to a traditional paper-based group case study on students' knowledge about obesity assessment, prevention and treatment, as well as determine students' satisfaction with the online module experience. It was hypothesized that students in the online module group would have a significant increase in score from pre-test to post-test compared to the paper-based group. It was also hypothesized that students would be satisfied with the case study module, as it simulated real-world experience.[14] Case-based learning is situated on a continuum between teacher-directed and student-directed problem-based

learning,[13,15] which are both grounded in constructivist learning theory that views the student not as a receiver of knowledge but a co-constructor of learning through comparing new information to previous experiences.[31] Students develop critical thinking skills through reflecting on what they know and what they need to know and acquire knowledge through co-construction in social interactions.[31-33] This case-based learning module was designed to facilitate students' sharing their knowledge and perspectives to engage in the nutrition care process (ie, assessment, diagnosis, intervention, monitoring and evaluation) for the case study client, as well as reflect on their own learning. The case study is scaffolded[34] in that students receive small pieces of information about the case at a time and are asked to determine what they know and need to know while engaging with their peers through discussion board postings. The case study is designed to provide students with information as they need it, much as a clinician goes through the process of nutrition assessment. In addition, students are provided with supplemental content relevant to the course, as well as directed to credible resources.

Materials and Methods

Study Design. This pre-test/post-test study assessed changes in knowledge about nutrition assessment for clients with obesity (medical nutrition therapy I) and nutrition counseling and obesity management (clinical nutrition interventions) after participating in an online collaborative case-based learning module. Students were randomized to either the traditional paper-based case study or online case-based learning module group in the Fall 2013 class (medical nutrition therapy I) and then completed the alternative case study format the following semester in the clinical nutrition interventions class. Self-evaluation of learning essays were collected in the online group each semester to expand understanding[35] of students' learning in the module. Student satisfaction was assessed via an online survey of students in the online case-

based learning group each semester. Finally, students in the online module groups were invited to participate in a focus group each semester to share their experiences with the online case-based learning module.

Development of Modules. The focus for the online modules in the medical nutrition therapy I and clinical nutrition interventions classes was utilization of the Nutrition Care Process[4] in the treatment of obesity.[5] This two-semester sequence of senior-level courses is required for dietetics students. Content to be covered in these courses was determined based on recommendation from a team of four faculty members and one graduate student, four of whom were registered dietitians. The goals and objectives for this sequence of courses, which were developed in collaboration with the instructor for these courses, are listed in Table 6.1. The framework for the two modules was nutrition assessment of a new client referred for weight management with multiple individual, family, and environmental factors impacting weight in the first semester, with the six-month follow-up appointment occurring in the second semester module. During the follow-up, students explored barriers to behavior change based on theories of behavior change and motivation and appropriate goal setting.

The first case study began with the initial nutrition assessment of a young adult female, aged 30 years. During the case study, students assessed dietary intake, engagement in physical activity, and personal, family, and environmental barriers to healthy eating and physical activity; determining a nutrition diagnosis; developing a P-E-S (problem – etiology – signs/symptoms) statement; and completing an initial nutrition assessment progress note and plan for intervention. Activities, topics, and objectives for each section of the case study are listed below (Table 6.2).

The second case study delivered the following semester began with the client returning for a six-month follow-up appointment, at which time she had lost 10 lbs. but felt that she had

reached a plateau. Students completed a follow-up assessment progress note, specifically focusing on positive behavior changes; explored theories of behavior change and motivation and applied these theories to redirecting the client to problem-solving; and determined appropriate behavior change goals based on S.M.A.R.T. criteria.[36] Activities, topics, and objectives for each section of the case study are listed below (Table 6.3).

In order to examine the effectiveness of the online collaborative modules compared to traditional paper-based case studies, the course instructor selected and modified case studies for the control group. Attention was given to ensure that a similar list of resources was available, as well as that students were exposed to similar information and that the objectives were the same as for the online case study module. The paper-based case studies provided general case information and a list of questions to answer. Students were assigned to groups of a similar size to complete the cases, but all case information was made available at one time point. Student groups were responsible for decisions on how to complete the case study, and group interactions and communications were not facilitated by the instructor. However, students in the paper-based case study groups could ask questions about the case and had access to a group discussion board.

Participant Recruitment. Students in a senior-level medical nutrition therapy I course and clinical nutrition interventions course were invited to participate in the study through an in-class announcement by the co-principal investigator (WB) in Fall 2013 and Spring 2014, respectively. All students in the class were required to complete either the online case study module or a traditional paper-based case study as an assignment; however, students participating in the study consented to allow their pre-test, post-test, and/or materials from their case study to be analyzed (ie, student satisfaction surveys and self-evaluation of learning essays were only collected when students participated in the online modules).

Before the case study began, students in the medical nutrition therapy I class during Fall 2013 were invited by WB to participate in a focus group to learn more about students' previous experiences with collaborative learning and case studies (Appendix D). The goal was to inform the structure and delivery of the modules. However, only one student participated in a one-on-one interview and therefore the data was not analyzed because the intent was to gather a variety of perspectives about case study and group work experiences. In Fall 2013, students in the medical nutrition therapy I class were stratified based on score on the first class test (score above mean vs. score below mean) and consent status (consent vs. no consent) and randomly assigned to either the traditional paper-based case study group or online case study module group to ensure that baseline ability would be relatively equal in both groups. Because the first class test score was utilized as a general stratification variable only and not retained for further analyses, consent for use of this score was not obtained from students. Four lists of students (above-mean pre-test score/consent to participate in the study, above-mean pre-test score/no consent to participate in the study, below-mean pre-test score/consent to participate in the study, and below-mean pre-test score/no consent to participate in the study) were generated, and students within each group were alternately assigned to the overall online case study group or traditional paper-based case study group. Students were then assigned to their respective group (online or paper-based) in the learning management system (Desire2Learn®). Within each group treatment, students were randomly assigned to work groups of six by the learning management system. In Spring 2014, students completed the alternative format case study in the clinical nutrition interventions class (i.e., online group completed the paper-based case study and paper-based case study group completed the online case study), staying in their work groups from the previous course. Students who were not in medical nutrition therapy I in Fall 2013 were assigned to

traditional paper-based case study work groups (ie, groups with fewer than six members due to four students who graduated/were not enrolled in the clinical nutrition interventions class) because the primary interest of the study was to examine students' experiences with the online case-based learning modules, and new group members could have potentially added a confounding variable in the online groups. Their scores were not included in analyses because they had not participated in an online case study, as the paper-based group had completed the online module in Fall 2013, which could have added a confounding factor.

After completing the case study, students in the online groups during Fall 2013 and Spring 2014 were invited to participate in a focus group to share their experiences with the online case study module. Students were offered extra credit for participating in a focus group. Students who did not wish to participate in the focus group or who were in the paper-based case study group were offered the opportunity to submit a reflection about their experience in their case study (i.e., what worked well, what could be improved) as an alternative extra credit assignment. The focus groups were announced during class and a message was posted on the learning management system (Appendix E). All procedures and protocols were approved by the Human Subjects Institutional Review Board of the University of Georgia.

Module Delivery. Each part of the modules (seven in the medical nutrition therapy I module and nine in clinical nutrition intervention module), which included PowerPoint® presentations with case study information and assignment instructions, supplemental PowerPoint® presentations addressing pertinent topics, and links to external web sites, were opened at designated intervals over approximately three to four weeks so that students focused on current information provided. For discussion board assignments, students were asked to post an original response to the guiding questions and respond to at least two other students. Group

assignments were uploaded to dropboxes in the learning management system. The facilitator (WB) monitored the discussion boards and provided additional guidance or questions as needed. WB posted a comment or question at least once in each group's series of discussion boards, provided feedback for assignments uploaded to the dropboxes, and responded to e-mail questions by students. WB also posted general announcements and reminders about upcoming assignments due to the "News" section of the learning management system.

It should be noted that several topics relevant to the online case study, such as dietary assessment methods and theories of behavior change, were presented during in-class lectures. However, the lectures were not obesity-specific. The course instructor was aware of the topics relevant to the case study and made an effort to ensure that such material was discussed in a general manner and not related specifically to either case study.

Data Collection. Students completed a pre-test approximately one week before the first part of the case study opened and the same post-test approximately one week after completing the case study (FDNS 4500 Medical Nutrition Therapy I Appendix I and FDNS 4520 Clinical Nutrition Interventions Appendix J). In the medical nutrition therapy I class, the 22-question multiple choice and short-answer test included topics related to nutrition assessment domains, uses for and concerns about dietary assessment methods, health risk assessment using BMI and waist circumference, risk factors for chronic disease, readiness to change, energy needs for weight loss, nutrition intervention, and monitoring outcomes. In the clinical nutrition intervention class, the 21-question multiple choice and short-answer test included topics related to environmental and psychosocial determinants of health, theories of behavior change and motivation, adjunctive pharmacotherapy and bariatric surgery, goal setting, nutrition intervention and monitoring outcomes. The questions were reviewed by the course instructor for clarity and

readability. The pre-test included questions about participant demographics, such as race/ethnicity, year in college, and major in the medical nutrition therapy I class only. The pre-test and post-test were offered through the learning management system. Students also completed a 15-item five-point Likert-scale student satisfaction survey that included two open-ended questions (Appendix K) to assess their experiences with the online case study module. The scale asked students to indicate their level of agreement with each statement as "Strongly disagree," "Disagree," "Neither agree nor disagree," "Agree," and "Strongly agree." Finally, the self-evaluation of learning essays from the online group were collected for analysis through a dropbox in the learning management system.

Focus groups data collection. A convenience sample of students in the online groups during Fall 2013 and Spring 2014 participated in a total of three focus group interviews (one Fall 2013 and two Spring 2014). Students read a consent script and signed a consent form before the interview began (Appendix E). Participants were assigned a random number by which to identify themselves to protect their identity during the audio recording. WB served as facilitator and read the consent script and protocol before beginning the focus group. WB followed the focus group protocol (Appendix E) and probed for expanded responses as needed. Participants were encouraged to talk with each other about the topics rather than answer questions in a round-robin fashion.[37,38] The goal was to gather information from a variety of viewpoints rather than come to a consensus.[37] An independent graduate student was available as a note-taker during one focus group in Spring 2014 and was encouraged to ask questions, as well. Each session was audio recorded, and notes were taken from listening to the audio recordings. Each session was then transcribed verbatim and the recording deleted.

Quantitative Data Analysis. Multiple-choice questions on the pre-test and post-test were automatically scored by the learning management system. Short answer questions were scored by an independent grader, who was blinded to student identity, based on a rubric developed by the WB during Fall 2013 and Spring 2014. WB reviewed the scores in the learning management system for consistency and adjusted if necessary, such as when a score was not saved by the learning management system. SPSS v. 22 for Mac (IBM, Armonk, New York) was used for all statistical analysis.

Descriptive statistics (frequencies) for demographic data and student satisfaction survey items were reported. Chi-square (χ^2) analyses were conducted to determine if there were any differences in demographic characteristics between the online and paper-based case study groups. Pre-test and post-test scores were calculated. A paired t-test was used to determine changes in knowledge from pre-test to post-test for the classes overall. Change in score for each question was calculated as a new variable. Chi-square analyses (χ^2) comparing online and paper-based groups were used to determine differences in percentage of students who received full, partial, or no credit for each question at pre-test and post-test, and an independent samples t-test was used to determine differences in change in score for each question, as well as to identify topics with which students were already familiar or problematic questions. An independent samples t-test was used to determine differences in changes in knowledge for students who scored below or above the mean on the pre-test, as well as for students in the online versus paper-based groups. A two-way ANOVA tested if there was an interaction between baseline knowledge and case study format for change in score. ANCOVA was used to determine if there was a difference in post-test scores by case study format after controlling for pre-test score. An independent samples t-test and one-way ANOVA were used to determine any differences in

changes in score based on demographic data. Statistical significance was determined based on a two-sided *P*-value <0.05.

Qualitative Data Analysis. Individual self-evaluation of learning essays were uploaded to NVivo v. 10.2 for Mac (QSR International, Doncaster, Victoria, Australia). Each student's identifying information was removed and replaced with a number code. Essays were read for each of the learning questions (i.e., what did you learn in this case study, what do you want to learn more about, and how will you use what you learned in practice?), and responses were coded using content analysis.[39] Notes from the focus groups were also uploaded to NVivo and coded using content analysis.

Results

Change in Knowledge (Medical Nutrition Therapy I, Fall 2013)

A total of 49 out of 71 students consented to participate in the study, with 25 randomly assigned to the online and 24 randomly assigned to the paper-based case study groups. Four (4) students in the paper-based group had incomplete or missing post-test data, and one (1) student in the online group had a pre-test score that was considered an outlier using the box-graph outlier labeling rule.[40] These students' scores were removed from further analyses. Students whose scores were not included in analyses (ie, missing data or did not consent to participate in the study) did not differ from those students whose scores were included in analyses for any demographic characteristic except race/ethnicity ($p = 0.040$). A higher percentage of Asian students did not consent to participate in the study (73% vs. 27% consented). Of students whose scores were included in analyses, there were no statistically significant differences between students in the online and paper-based case study groups for any demographic variable (Table 6.4). Students were 77% non-Hispanic white, 93% female, and 67% fourth-year undergraduates.

After initial question analysis, it was determined that one question was problematic (question #17) due to the number of students who misinterpreted the question based on their responses. This question was not included in the final pre-test and post-test scores. Question analyses also revealed that most students were aware of the problems associated with various dietary assessment techniques, recommended lifestyle changes to reduce risk for chronic disease, and recognizing motivation to lose weight. Chi-square analyses (χ^2) of the post-test score showed that a greater percentage of students in the online group compared to the paper-based group correctly identified specific anthropometric, medical, or laboratory values associated with increased risk for chronic disease (32% vs. 15%, respectively, $p = 0.003$), while a greater percentage of students in the paper-based group correctly calculated and categorized the client's BMI compared to the online group (95% vs. 72%, respectively, $p = 0.045$) (Table O.1) Specifying anthropometric, medical, or laboratory values was emphasized during the online case study in the P-E-S Statement discussion board and likely contributed to this finding, although this information was also presented in class and was addressed in the paper-based case study. A paired t-test showed a small but non-significant increase in score from pre-test to post-test for all students ($3.2\% \pm 12.0$, $p = 0.08$) (Table O.2). T-tests and one-way ANOVA did not reveal any differences in change in score based on demographic variables (Tables O.3, O.4, and O.5). There was a small but significant difference in change in score based on case study format, with a mean change of 6.5% for the online group compared to -0.6% for the paper-based group ($p = 0.05$) based on an independent samples T-test (Table 6.5). Results from the ANCOVA analysis showed that there was a significant difference in post-test score for the online group compared to the paper-based group after adjusting for pre-test score (73.7% vs. 65.8%, respectively, $p = 0.008$), which accounted for almost 16% of the variance in score (Table 6.6). In comparing

change in score based on baseline knowledge (pre-test score below vs. above mean), students with less baseline knowledge increased their score significantly compared to students with higher baseline knowledge (Table O.6). Therefore, a two-way ANOVA was conducted to determine if there was an interaction between the case study format and baseline knowledge (Table 6.7). There was a significant difference in change in score based on case study format, baseline knowledge, and a trend towards significance for the interaction between the two. It seems that the online case study format was more beneficial for students with less baseline knowledge, as their mean score at post-test was nearly equal to students with greater baseline knowledge in both groups.

What students expressed they learned (qualitative analysis). Students in medical nutrition therapy I reflected on their learning experience by articulating what they learned in the online case study, what they wanted to learn more about, and how they would use what they learned in practice. Students were also asked to consider how they would motivate the client to continue her weight loss journey if she had not lost weight at a one-month follow-up visit. Figure 6.1 illustrates the overall themes that emerged from the reflections.

In considering what they learned, the majority of students expressed learning "dietetic practice skills," such as nutrition assessment, and how to write P-E-S statements.

> "I also have learned how to correctly write a nutrition diagnosis using the PES formula and learned the importance of prioritizing diagnosis. Often times, patients have more than one nutrition problem and it is the job of the dietician to determine which problem is the most pressing and should receive the most attention" (Participant #1043).

Students appreciated an opportunity to experience the nutrition care process in a simulated experience:

> "As dietetics students, we see the process for the parts, not how they all interrelate and function as a whole. I learned how to appropriately assess a patient from the beginning, and then use these assessments to determine a course of action that would lead the patient to the right outcome" (Participant #1025).

Students focused on theories of motivation and "behavior change" in encouraging the client if she had not lost weight at follow-up. Many students expressed ensuring that the client had social support for behavior change, which is consistent with self-determination theory of motivation.[41]

> "I'd also ensure that her family was supporting her lifestyle changes, because it's much easier to follow through when you aren't doing it alone" (Participant #1004).

Several students also planned to encourage the client to see herself as a "role-model" for her daughter, which incorporates the idea of helping the daughter learn healthy eating and physical activity habits through modeled behavior from social cognitive theory.[42]

"Client support" was also a key strategy to motivate the client to continue her weight loss journey. Several students planned to use positive reinforcement to support the client's behavior change, as well as reassure her of "normal weight loss" patterns.

> "I would try to help her stay motivated by explaining to her that it is normal & healthy to only lose 1-2 pounds per week" (Participant #1013).
>
> "If she does not lose as much weight as she expects, I could keep her motivated by complementing her on her progress so far and to keep up the good work. Positive

reinforcement for weight loss works better for keeping individuals motivated rather than putting her in a negative mood by saying how she should lose more weight or she should work harder" (Participant #1045)

Finally, students expressed learning about a holistic approach to client care by considering multiple factors in nutrition assessment and shifting outcomes focus from weight to other measures of health.

"In this case study, I learned that family, work, and food availability have a large impact on dietary habits. Dietary habits can be hard to break especially if family members do not support Crystal's efforts and motivation to live healthier lifestyle" (Participant #1022)

"I want her to assess her energy level and see how she is feeling and see if she feels a difference in herself. As long as she is beginning to see a change in her own body, than the weight will begin to come off in time" (Participant #1012)

Change in Knowledge (Clinical Nutrition Intervention, Spring 2014)

A total of 48 out of 69 students consented to participate in the study. However, six students' scores were not included in the final paired t-test, t-test, and ANOVA analyses: one student did not complete the pretest, three students had not been enrolled in the Fall 2013 medical nutrition therapy I class, and two students had a difference between pre-test and post-test scores considered as outliers based on the box-graph outlier labeling rule.[40] There were no significant differences between those students whose scores were included in analyses and those whose scores were excluded for any demographic variable except race/ethnicity (35% of excluded scores vs. 7% of included scores, $p = 0.018$). The majority of students, as with medical nutrition therapy I, were female (95%), non-Hispanic white (76%), and fourth-year

undergraduate (73%), and there were no significant differences between students in the online group and paper-based group for any demographic characteristic (Table 6.8).

After initial question analysis, it was determined that two questions (#8 and # 19) represented a high level of baseline knowledge that did not change at post-test. Therefore these questions were excluded from further analysis. Students did have prior knowledge of environmental factors influencing eating decisions but not physical activity decisions, and practical goal setting (Table O.7). Chi-square analyses (χ^2) of the post-test score showed that a greater percentage of students in the online group compared to the paper-based group correctly identified the health belief theory as the focus of Strong4Life's television ads (65% vs. 35%, respectively, $p = 0.039$). Students in the online group had viewed a supplemental PowerPoint® presentation about behavior change theories and discussed them in a discussion board.

A paired t-test showed a small but statistically significant change in score from pre-test to post-test for the class as a whole ($4.1\% \pm 9.4$, $p = 0.007$) (Table O.8). There was not a statistically significant change in score based on case study format (Table 6.9) but there was a significant change in score based on baseline knowledge (Table 6.10). A two-way ANOVA showed no significant effect of case study format or an interaction between case study format and baseline knowledge on change in score (Table 6.11).

What students expressed they learned (qualitative analysis). Figure 6.2 illustrates the thematic domains that emerged from students self-report of learning among students who completed the online case studies. The majority of students noted that they learned about the "process of counseling" and viewed the case study module as demonstrating an effective step-by-step process to address clients' needs.

"This case study was very helpful in introducing us to a practical and efficient way of caring for obese patients. It gave constructive, step-by-step methods to assessing, caring for, and prescribing adequate treatment." (Participant #1014)

"There were many things I liked about this case study. First, I thought this topic was very useful. I anticipate serving most of my clients who are dealing weight management issues. Moreover, the case study was very broken down into practical steps that we would need to take dealing with this chronic issue of weight management." (Participant #1021)

Students felt that the online module provided them a good introduction to nutrition counseling but desired more experience.

"I need to learn more about some counseling techniques that lets the client talk their own way through the problems and they come up with solutions. Obviously I will be giving them some suggestions and educating them on nutritional information so that they have a good starting point for making changes. I also need to learn more about different suggestions to make to clients based on their unique situations." (Participant #1018)

Many students reported learning about "S.M.A.R.T. goal setting," especially helping clients evaluate their goals to determine if they are appropriate and achievable. One student recognized the application of this concept to his or her own life.

"Something I learned the most about was the SMART method for assessing goals. Honestly, it's so "smart" that it can be used in even my own life's situations." (Participant #1021)

Students also focused on "client-centered counseling," most often recognizing that clients must set their own goals rather than simply follow what the dietitian suggests.

> "It is important to help the client establish their own goals rather than simply telling them what they should and shouldn't be doing. By allowing the client to set their own goals, it inspires self-confidence in them and also ensures that the goals are achievable for them and fits into their current lifestyle." (Participant #1002)
>
> "The last portion of this case study was to create a contract with Crystal. This was an important part of Crystal's weight management because she was able to choose her goals, and she will sign a contract to hold her accountable to meet her goals."
>
> (Participant #1008)

Finally, students also expressed learning about client "resistance and barriers to change" and desired to learn more techniques to work with difficult clients.

> "Many people believe obesity can be treated through a simple nutrition/exercise plan, however, it is very clear now that there are complex psychological barriers that are present in most cases. This study helped us to understand which barriers may arise in these patients, as well as provided a constructive method which may help in properly diagnosing and treating them." (Participant #1014)
>
> "I would also like to know more about how to deal with difficult clients. Though we did get some resistance and frustration from Crystal, she seemed mostly cooperative, which I know will not be the case with all counseling clients we see." (Participant #1002)
>
> "I need to practice on dealing with different people and their different emotions and situations." (Participant #1006)

Student Satisfaction

Student Satisfaction Survey. Overall, students were satisfied with the content of and skills gained in the online case study modules (Tables 6.12 and 6.13). Cronbach-alpha was 0.830 for Fall 2013 and 0.783 for Spring 2014, showing that it is an acceptable measure of satisfaction. The majority of students in both classes agreed or strongly agreed that the group discussions helped them think about additional information they had not initially considered, that the final group assignment helped them develop skills they would use in practice, and they felt confident in their skills to address obesity in a similar situation and to find credible information about obesity prevention and treatment. However, students were not as satisfied with the technical aspects of the case study. Only 54% and 19% found it easy to navigate the learning management system for the medical nutrition therapy I class and the clinical nutrition intervention class, respectively. Some of the difficulty may have been related to the change in learning management system in Fall 2013, followed by an update in Spring 2014.

Interestingly, students were less satisfied with group activities, although the majority believed that group discussions were beneficial. This likely is associated with the difficulty working with groups expressed by many students. In the open-ended questions of the student satisfaction survey, the majority of students expressed that group discussions were helpful in their learning, mostly because it helped them understand a different perspective or see information they had not considered. However, several students desired the case study to be an individual assignment, more so in medical nutrition therapy I class compared to the clinical nutrition intervention class. Also, several students in the medical nutrition therapy I class preferred to receive a case study all at once with one due date, which is the format to which they

are accustomed in other classes. A few students noted that it was difficult to organize group work to ensure that everyone contributes.

Focus group discussions. A total of seven (7) students participated in the focus group in Fall 2013, and ten (10) students participated in two focus groups (six in the first focus group and four in the second focus group) in Spring 2014. When asked what was something interesting learned in the online case study, students noted that the extensive background information about the client and her family created a sense of a realistic counseling situation in which recommendations could be personalized based on assessed needs. Participants in the medical nutrition therapy class recognized that multiple factors were impacting the client's decisions; however, they felt unprepared to tell the client how the family was impacting her choices, as they did not want to overstep their boundaries. In the clinical nutrition intervention focus groups, participants expressed that they felt like they were working one-on-one with a client in a "progressed way," that it was not a one-time visit with one recommendation. They appreciated feeling that they were following the client over time, and that they saw the change in client's motivation (which declined during the case) and the need for them to explore different ways to re-motivate her. Students in the second clinical nutrition intervention focus group learned "how impatient some patients can be" and the need for a "patient patient and patient counselor" to address the desire for quick-fix weight loss.

Students appreciated the opportunity to apply what they were learning in class to what they will likely see in their future work. In the Fall 2013 focus group, one student noted that in class, not all of the pieces fit together, but the realistic case study helped her see how different concepts are combined to help a client. Students in both classes noted that most case studies and material learned in class related to a particular disease state, and they expected to treat the

situation as “black and white” with correct and incorrect answers. Weight management was different because the client may not necessarily be unhealthy (ie, with an active disease state). One student in the clinical nutrition intervention class noted that motivation for weight loss is not always health-related – health benefits may be a perk, but usually the client is focused on psychological and aesthetic reasons for change. Students also felt like this was their first experience with counseling a client and seeing the results of their session through follow-up. One student noted that in a paper-based case study, the client would “never say ‘no’ to you,” so experiencing the resistance was an important learning opportunity.

One critique for the content of the modules was a desire for more scientific, evidence-based information. Students in the clinical nutrition intervention class noted that they appreciated it when their peers provided references for their responses to discussion board prompts. While they valued sharing opinions and learning from others’ perspectives, students wanted a balance between expressing opinions (subjective) and facts (objective). Therefore, future modules will likely provide prompts for documenting evidence for particular recommendations.

Despite the student satisfaction survey showing that some students had difficulties with their groups, most of the participants in the focus groups expressed enjoying working with their groups. Overall, they felt that they learned from reading peer’s discussion board posts and that their peers often presented novel ideas and strategies for interventions that they would not have considered otherwise. One participant in the clinical nutrition intervention class noted that other students in the group responded more eloquently to the client, and so this participant desired to emulate their style in the future.

A few students mentioned that their groups included one or two students who didn’t participate despite attempts to contact them. Several students discussed that their group members

completed group assignments as individuals, and then the group would check what was already submitted. Many students mentioned alternative group collaboration strategies, such as using Google Docs® to gather input for a group assignment and private Facebook® groups to communicate upcoming deadlines and delegate tasks. Several groups exchanged contact information, and one group leader texted and e-mailed upcoming deadlines to group members.

Most of the discussion about challenges in the online case study focused on the learning management system. Some students were confused by which assignments were individual or group. Because they had participated in both the paper-based case study and online case study, students in clinical nutrition intervention class were asked about the advantages or disadvantages of the online module. Groups tended to divide question responsibilities for paper-based case studies, so they recognized that they might miss learning some information if the group did not review the final paper before submission. In addition, group members may have to "take up the slack" if someone doesn't complete their section. One student noted that having to do the online module on her own provided a more thorough learning experience. Students also noted a greater connection with the client because it felt like ongoing sessions and interactions. Students did recognize that more scientific, evidence-based information was required in the paper-based case study, which also facilitated learning. In thinking about other ways to learn about obesity management, students suggested video simulations, working one-on-one with a standardized client, guest lecturers from the field, and observing a patient consultation.

Discussion

Several studies have examined the effectiveness of online learning or case-based/problem-based learning but rarely a combination of the two methodologies. Online modules have been shown to be an effective medium to facilitate learning in the health sciences.

For example, Wallner et al[20] developed and implemented an online continuing education course to train registered dietitians, dietetic technicians registered, nurses, and extension educators about food safety issues of high-risk populations. Participants increased scores from pre-test to post-test (67.3% vs. 91.9%), which was a significant change in score.[20] Similarly, Puri et al[23] utilized computer-assisted instruction (CAI) to facilitate dietetics students' learning about nutrition counseling techniques and found a small but statistically significant increase in knowledge from pre-test to post-test for the intervention group receiving the CAI modules. Litchfield et al[26] developed and implemented three online learning modules for their dietetic interns that included group discussions, chat room collaboration, and simulation exercises. Although the researchers did not show a significant difference in change in knowledge for two of three modules,[26] they did show a significant difference in key feature exam scores for students participating in the online modules compared to those who did not.[25] The researchers believed that key feature exams may provide a better indication of student's ability to transfer knowledge to practice because they focus on "critical steps" in solving a clinical problem rather than comprehension only.[26] Other studies have not found differences in change in knowledge based on participation in an online intervention.[43,44]

Similarly, results of studies examining the effectiveness of case-based or problem-based curricula or modules are mixed.[13-15] Most studies report that students appreciate the realistic nature of cases[17] and ability to simulate real-world experiences that are difficult to duplicate in class or internships.[14] There is some evidence that case-based learning or problem-based learning increases critical thinking skills, as students tend to exhibit better clinical reasoning skills if not absolute gains in knowledge.[18,45,46] Lohse et al[18] implemented two problem-based learning modules (intervention) in a life cycle nutrition class and found no significant differences in

knowledge retention after three months for students participating in the modules compared to those who were in the lecture-based group. However, the researchers found that students in the intervention group showed more evidence of critical and reflective thinking and less reliance on memorization than their lecture-based counterparts. Recently, Harman et al[19] examined student learning and perception of immersive case-based learning experiences in two upper-level dietetics courses. The researchers reported that students saw the "Big Picture" through using a realistic story or scenario as a method to learn problem-solving skills that would be used in future professional practice. Students seemed to recognize the development of critical thinking skills through case-based learning.[19]

The results of the present study are similar to previous research about effectiveness of both online and case-based learning instruction. In medical nutrition therapy I, there was a significant increase in knowledge for students in the online group compared to students in the paper-based group. When adjusting for pre-test score, a significant difference in post-test score favoring the online group emerged. These findings are similar to what Puri et al[23] found with students using supplemental computer-assisted modules, although there was a significant difference in score from pre-test to post-test for students in the tutorial group in that study. These modules provided instruction about topics similar to the module in clinical nutrition intervention in the present study; however, their modules utilized video simulation and interactive computerized feedback. The module in the current study was relatively "low-tech," which may not have provided an equally immersive experience. There was not a difference for change in score in clinical nutrition intervention. The relatively small sample sizes in the current study decreased the likelihood of finding a significant difference between groups.

In medical nutrition therapy I, the impact in change in score was greater for students who had scored below the mean on the pre-test (17.4% vs. -1.4%, $p < 0.045$). Zimmerman et al[47] examined the difference in change in score for critical thinking of allied health graduate students who participated in either interdisciplinary or single discipline case study discussion groups and found that student in the interdisciplinary group who scored below the median on the pre-test had significantly improved scores at post-test. Although all students in the current study were dietetics majors, it is possible that the interaction through the discussion boards fostered learning through reading peers' perspectives. In the study by Zimmerman et al, students in the interdisciplinary group noted that the case study groups "made them think about different points of view" and "realize the importance of other's opinions."[47]

Although the online case studies are designed to provide a complete education about obesity management, they likely function best as a supplement to face-to-face classes. The material in the clinical nutrition intervention course is, for the most part, not presented in any other course. Therefore, the concepts related to nutrition counseling are relatively new for students, whereas several topics from the medical nutrition therapy I case study are also covered generally in some prerequisite courses It is possible that the online case study module facilitates simulated practice for knowledge and skills to which students have had multiple exposures. However, there was a trend towards a significant difference in pre-test score for the online versus paper-based group in clinical nutrition intervention, which may have contributed to not finding a significant difference in post-test score or change in score based on group membership.

Overall, students were satisfied with their experiences participating in the online modules as evidenced by scores for the student satisfaction survey. Students participating in the focus groups felt that the case study simulated a realistic situation with a client whom they followed

through multiple interactions. Students appreciated the background information that helped them understand how recommendations need to be tailored to the client's needs. These findings are similar to what Harman et al[19] found in that students felt they experienced the overall process of nutrition counseling from start to finish ("the big picture"). They felt that they learned from group members' different perspectives, as other students presented novel strategies and interventions for helping the client, as well as some modeled "soft skills" such as being less blunt with a client. Students did desire incorporating more scientific evidence for recommendations given to the client. However, they did appreciate the opportunity to share their opinions with others.

Unfortunately, students were less satisfied with the technical aspects of the case study. They desired more clarity about due dates and if assignments were individual or group, which is consistent with findings by Connors[48] in which posting a schedule and maintaining a predictable pattern of activities was recommended. Some also struggled with navigating the learning management system. A few participants expressed difficulties communicating with some group members, but overall students seemed to negotiate group work, often through outside collaboration tools such as Facebook® or Google Docs®. For the most part, students were more satisfied with the online case study compared to the paper-based case study, as it was manageable through smaller assignments, provided more details about the client, and fostered continued participation rather than completing the case study in one to two days. One student in medical nutrition therapy I felt that she "was less stressed" compared to what she heard from peers in the paper-based group because she had to work part-by-part rather than procrastinate,

and a student in clinical nutrition intervention believed that this was the "least invasive" group project she had seen because it was online and did not require rearranging her schedule to meet with group members.

There were several limitations in the current study. Although students were randomized to either the online group or the paper-based group, it is not known if any information about experiences was shared between the groups. In one of the focus group sessions, a participant mentioned that she perceived her peers in the paper-based group as more stressed due to waiting until the deadline to complete the case study. In addition, several students in the online group in clinical nutrition intervention had participated in a similar online module in another course earlier in the same semester. It is possible that participating in two online modules may have allowed them to be more comfortable with the process. Lohse et al [18] recommended additional time for students to acclimate to problem-based learning, so it is possible that multiple exposures changed the way these students approached the module. Similarly, it is not known if students who had participated in the online group in medical nutrition intervention I changed the way they approached the paper-based study in clinical nutrition intervention, although regression analyses did not show a difference in change in score based on which case study format was experienced first (data not shown). Therefore, other factors may have impacted students' scores in clinical nutrition intervention. Another limitation is that it was difficult to control for information students had received from other coursework. However, the purpose of the study was to examine the effectiveness of modules that would be delivered as supplements to traditional classroom learning as a component of a standard dietetics curriculum.

In analyzing the qualitative data, there were additional limitations in this study. First, only one researcher (WB) coded and analyzed the self-reflection of learning essays. Ideally,

additional team members code qualitative data separately and then come to a consensus about the nature of the codes. Because this study was a pilot project with a limited budget, it was felt that it was sufficient for WB to code and analyze the data without consulting other team members, who were not trained in qualitative analytic techniques. WB consciously analyzed the essays at least 2-3 months after collecting them to assure "distance from the data," so that it could be read more objectively. WB also systematically approached the analysis through reading all essays in total before reading each essay for the prompt questions. Similarly, WB was the facilitator for the focus group sessions, which may be a limitation, as participants knew the invested interest of the researcher and may not have wanted to express negative opinions. When a few students "complained" about the learning management system, they often added, "but I know that wasn't your fault," afterwards. So, students may not have been as open about negative opinions as they would have been with an independent facilitator. In addition, some group members were in the same focus group session, and they may have been uncomfortable sharing openly with someone with whom they worked.

This study also had several strengths. It was a pre-test/post-test study design that attempted to control for students' baseline knowledge in medical nutrition therapy I by stratifying students based on scores on the first in-class test. Therefore, in medical nutrition therapy I, there was no significant difference in pre-test score based on group membership. In addition, self-reflections of learning provided additional information about what students perceived they learned. Students expressed learning about the nutrition care process and nutrition counseling, which were emphasized in these two modules. Therefore, students seemed to meet the learning objectives of the modules. Finally, information about student satisfaction was collected through both a student satisfaction survey and focus group interviews. Overall, both

sets of data indicate that students appreciated the nature of the case study and felt that they gained skills used in practice; however, students were less satisfied with technical issues of the learning management system.

Conclusions

The present study combines online and case-based learning to determine its effect on students' knowledge and skills about obesity prevention and treatment. Overall, there was a small but statistically significant increase in knowledge for students in the online group in medical nutrition therapy I but not clinical nutrition intervention. Students were satisfied with the content of the modules and the simulated experience of counseling a client about weight management over time. However, technology and other logistical issues were problematic for some students. Future research should examine students' preferred learning platforms, such as Facebook® groups or dedicated web sites for case study delivery, as universities may change learning platforms. In addition, students desire more simulated experiences, so including interactive video components may further enhance such case-based learning modules. Students appreciated the "blog" in the medical nutrition therapy I case study, seeing this as making the client a "real person." Overall, students perceived that they have learned valuable skills in these modules and that the experience was positive. Therefore, future research should examine effectiveness of similar modules to teach students about additional nutrition-related conditions.

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Table 6.1. Goals and objectives for online case study modules in two upper-level dietetics classes

	Goal	Objectives
Medical Nutrition Therapy I (FDNS 4500)	Students will understand the assessment and treatment of obesity and be able to gather appropriate information from a client in order to develop a Nutrition Care Plan.	• Students will be able to calculate energy needs and compare current dietary intake to estimated needs. • Students will be able to assess body composition (i.e., using BMI and weight classifications) • Students will be able to develop a weight management plan with the client that incorporates a socio-ecological approach.
Clinical Nutrition Interventions (FDNS 4520)	Students will understand criteria for weight loss interventions, as well as assist clients in problem-solving to manage their weight through motivational interviewing and behavioral counseling techniques.	• Students will understand various approaches to weight loss (i.e., both popular diets and the Dietary Guidelines for Americans, physical activity, pharmacological approaches, and bariatric surgery), criteria for using these approaches, and benefits and costs of these approaches. • Students will understand behavior change and motivation theories related to weight management. • Students will evaluate client goals to determine if they are S.M.A.R.T. • Students will develop a weight loss plan with clients and use nutrition counseling strategies to facilitate behavior change.

Table 6.2. Timeline of online case study activities in a medical nutrition therapy I class

Timeline	Activity	Objective
Week 1*		
Days 1-7	*What's Your Story?* Students keep a 4-day food and physical activity journal and reflect on the experience.	Students reflect on the experience of keeping a food and activity record to understand the difficulties many clients face when given this task in a counseling session
Week 2		
Days 8-10	*The client (Crystal)'s Story and Guiding Questions* Students receive a brief introduction to each family member and post their thoughts about the barriers (individual, family dyanamics, environmental) to weight management to the group discussion board. Students also review a supplemental PowerPoint® presentation about dietary assessment methods and post their thoughts about guidelines to help clients complete a food diary, 24-hour dietary recall, or food frequency questionnaire.	Students brainstorm about the client's challenges to behavior change related to family dynamics and her weekly schedule, as well as determine additional information needed from the client.
Days 10-12	*First Steps* Students review a supplemental PowerPoint® presentation about nutrition assessment for overweight and obesity, as well as follow the client's "blog" about her week monitoring what she eats. Students post their thoughts about the client's barriers and facilitators of behavior change to the group discussion board.	Students follow the client's blog entries to determine some of the barriers and facilitators of behavior change in her life, as well as foods and events that are important to her.
Week 3		
Days 12-17	*Next Steps* Students enter the client's 7-day food record into MyNetDiary, MyFitnessPal, or USDA Supertracker and compare to recommended dietary pattern, as well as certain nutrient intake recommendations for sodium, total fat, calcium, and vitamin D. Students then complete the assessment and diagnosis sections of the initial progress note. Students also post 1-2 P-E-S statements to the group discussion board.	Students use assessment information collected to determine a nutrition diagnosis and write a P-E-S statement.
Days 17-19	*Designing an Intervention* Students view a supplementary PowerPoint® presentation about weight management and post three behaviors that the client should focus on changing to the group discussion board. Students are asked to justify their responses with evidence-based recommendations. Students are also asked to think about how they would assess the client's readiness to change.	Students determine behavior changes that may most impact the client's health and consider how to address the client's needs.

Timeline	Activity	Objective
Days 17-19	*Follow Up* Students plan for the client's one-month follow-up visit by posting their thoughts about which outcomes they expect to see change, as well as which outcomes are most important to the client, to the group discussion board. Students also complete the initial progress note by completing the outcomes and measures section and arranging for follow-up.	Students discuss possible short-term outcomes that may result from the behavior changes the client chose to make.
Days 19-24	*Final Reflection* Students reflect on possible motivators to continue lifestyle changes when weight loss does not occur. Students also evaluate what they have learned, what they want to learn more about, and how they will use what they learned in practice.	Students brainstorm motivators other than weight loss to help a client stay on plan.

*Due to overlap of activities, weeks are approximated

Table 6.3 Timeline of online case study activities in a clinical nutrition intervention class

Timeline	Activity	Objective
Week 1*		
Days 1-5	*What's Your Story?* Students reflect on their own experience with behavior change, what challenges they faced, what helped them change, and have they maintained the new behavior or not.	Students reflect on their own experience with behavior change, noting facilitators and barriers, as well as discuss if they engaged in counseling for behavior change.
Days 3-8	*Follow-up with the client (Crystal)* Students learn that the client has lost 10 lbs., about 5 of which were in the first month. Students review the NIH Obesity Education Initiative Practical Guide to determine if the client is a candidate for weight loss surgery or pharmacotherapy. Students post their thoughts to the group discussion board, as well as topics they should consider to help the client understand why her weight loss has slowed.	Students consider the criteria for using adjunctive pharmacotherapy or weight loss surgery for the treatment of obesity.
Week 2		
Days 5-12	*A Bright Idea* Students review a supplemental PowerPoint® presentation about behavior change theories and the client's reflection about her weight loss and gain pattern. Students post their thoughts about potential patterns that emerge as facilitators and barriers to maintenance of a healthy weight to the group discussion board.	Students identify lifestyle patterns that may affect a client's weight.

Timeline	Activity	Objective
Days 10-17	*Focus on the Positive* Students review a supplemental PowerPoint® presentation about motivation theories. Using information from the client's reflection and follow-up medical information, students complete a follow-up nutrition assessment note. Students also post their thoughts about positive outcome changes and key behavior changes achieved, as well as which behaviors the client should now change to move beyond her plateau, to the group discussion board.	Students note positive changes in anthropometric, biochemical, physical findings, and behavior.
Week 3		
Days 15-19	*What Should I Do?* Overwhelmed with frustrated, the client states that she wants the dietitian to "tell me what to do." Students explore how to turn the conversation around with motivational interviewing and self-determination theory in mind and post their thoughts to the group discussion board.	Students engage client in identifying barriers to behavior change and develop solutions to address the barriers.
Days 15-19	*Quick Tip Sheet* Students develop a short tip sheet to identify common strategies to decrease fat and sodium intake, increase fruits and vegetable intake, and increase physical activity.	Students use their food and nutrition knowledge to develop practical tips for clients based on their needs.
Days 19-24	*Getting S.M.A.R.T.* Students review a supplemental PowerPoint® presentation about goal setting and evaluate the client's goals based on the S.M.A.R.T. criteria. Students post their thoughts about possible barriers the client will encounter to the group discussion board.	Students help clients define one or two goals using S.M.A.R.T. guidelines.
Week 4		
Days 24-29	*The client Is S.M.A.R.T.* Students review the client's revised goal and create a "goal contract" to hold her accountable.	Students develop a "contract" with client to document behavior change, measurable outcomes, and motivational assessment.
Days 24-29	*Final Reflection* Students watch a video about the 5 A's or obesity management and reflect on how they addressed the 5 A's in the case study. Students also reflect on what they learned, what they want to learn more about, and how they will use what they learned in practice.	Students reflect on how they implemented the 5 A's of obesity treatment, which helps practitioners treat clients holistically.

*Due to overlap of activities, weeks are approximated

Table 6.4 Characteristics of participants in a medical nutrition therapy I class (N = 44)

	Total n (%)**	Online case study n (%)**	Paper-based case study n (%)**	*P*-Value
Gender				0.45
Male	3 (7)	1 (4)	2 (10)	
Female	41 (93)	23 (96)	18 (90)	
Race/Ethnicity				0.71
Asian	3 (7)	1 (4)	2 (10)	
Hispanic	3 (7)	2 (8)	1 (5)	
Non-Hispanic black	3 (7)	1 (4)	2 (10)	
Non-Hispanic white	34 (77)	19 (79)	15 (75)	
Other	1 (2)	1 (4)	0 (0)	
Age (in years)				0.14
≤20	1 (2)	0 (0)	1 (5)	
21	24 (55)	13 (54)	11 (55)	
22	12 (27)	9 (38)	3 (15)	
≥23	7 (16)	2 (8)	5 (25)	
*Year in College**				0.50
Third-year undergraduate	1 (2)	0 (0)	1 (5)	
Fourth-year undergraduate	29 (67)	17 (71)	12 (63)	
Fifth-year or beyond undergraduate	13 (30)	7 (29)	6 (32)	
Intended or Declared College Major				-
Dietetics	44 (100)	24 (100)	20 (100)	

*One student did not respond
**Percentages may not sum to 100 due to rounding

Table 6.5. Change in knowledge of assessment of obesity in a medical nutrition therapy I class by case study format

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Paper-based group	20	66.5 (8.5)	65.8 (10.5)	-0.6 (10.0)
Online group	24	67.2 (12.5)	73.7 (8.6)	6.5 (12.8)

[a]p = 0.82 [b]p = 0.009 [c]p = 0.050

Table 6.6. Change in knowledge of assessment of obesity in a medical nutrition therapy I class by case study format, adjusted for pre-test knowledge

	Pre-test Score (%) (mean, SD)		**Post-test Score (%) (mean, SD)**
Paper Case Study	66.5 (8.5)		65.8 (10.5)
Online Case Study	67.2 (12.5)		73.7 (8.6)
ANCOVA for post-test score	F Statistic	P-Value	Partial Eta Squared
Case Study Format	7.8	0.008	0.160
Pre-test knowledge	6.1	0.018	0.129

Table 6.7. Change in knowledge of assessment of obesity in a medical nutrition therapy I class by pre-test score above or below mean and case study format

	Pre-test Score Below Mean		**Pre-test Score Above Mean**	
	Pre-test (mean, SD)	Post-test (mean, SD)	Pre-test (mean, SD)	Post-test (mean, SD)
Paper Case Study	60.4 (4.8)	63.9 (10.0)	73.8 (5.7)	68.1 (11.2)
Online Case Study	55.2 (8.3)	72.6 (9.3)	75.8 (6.2)	74.4 (8.4)
Change in Score	F Statistic	P-Value		
Case Study Format	11.3	0.02		
Pre-test knowledge	26.6	<0.001		
Format x Pre-test Knowledge	3.1	0.09		

Table 6.8 Characteristics of participants in a clinical nutrition interventions class (N = 42)

	Total n (%)**	Online case study n (%)**	Paper-based case study n (%)**	*P*-Value
Gender				0.15
Male	2 (5)	2 (10)	0 (0)	
Female	40 (95)	19 (91)	21 (100)	
Race/Ethnicity				0.85
Asian	3 (7)	2 (10)	1 (5)	
Hispanic	4 (10)	2 (10)	2 (10)	
Non-Hispanic black or other	3 (7)	2 (10)	1 (5)	
Non-Hispanic white	32 (76)	15 (71)	17 (81)	
Age (in years)				0.33
≤20	1 (2)	1 (5)	0 (0)	
21	25 (60)	12 (57)	13 (62)	
22	11 (26)	4 (19)	7 (33)	
≥23	5 (12)	4 (19)	1 (5)	
*Year in College**				0.66
Third- or fourth-year undergraduate	30 (73)	14 (70)	16 (76)	
Fifth-year or beyond undergraduate	11 (27)	6 (30)	5 (24)	
Intended or Declared College Major				-
Dietetics	42(100)	21 (100)	21 (100)	

*One student did not respond
**Percentages may not sum to 100 due to rounding

Table 6.9. Change in knowledge of nutrition counseling of clients with obesity in a clinical nutrition intervention class by case study format

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Paper-based group	21	61.1 (8.6)	63.6 (7.9)	2.5 (8.8)
Online group	21	55.2 (11.4)	61.0 (11.0)	5.8 (10.0)

[a]p = 0.07 [b]p = 0.39 [c]p = 0.26

Table 6.10. Change in knowledge of nutrition counseling of clients with obesity in a clinical nutrition interventions class by case study format, adjusted for pre-test knowledge

	Pre-test Score (%) (mean, SD)		**Post-test Score (%) (mean, SD)**
Paper Case Study	61.1 (8.6)		63.6 (7.9)
Online Case Study	55.2 (11.4)		61.0 (11.0)
ANCOVA for change in score	F Statistic	P-Value	Partial Eta Squared
Case Study Format	0.034	0.85	0.001
Pre-test knowledge	14.1	0.001	0.266

Table 6.11. Change in knowledge about nutrition counseling of clients with obesity in a clinical nutrition interventions class by pre-test score above or below the mean and case study format

	Pre-test Score Below Mean		**Pre-test Score Above Mean**	
	Pre-test (mean, SD)	Post-test (mean, SD)	Pre-test (mean, SD)	Post-test (mean, SD)
Paper Case Study	52.8 (5.5)	60.3 (6.7)	67.3 (3.8)	66.0 (8.2)
Online Case Study	47.8 (6.6)	56.5 (9.3)	67.3 (5.0)	68.3 (10.0)
Change in Score	F Statistic	P-Value		
Case Study Format	0.41	0.53		
Pre-test knowledge	9.23	0.004		
Format x Pre-test Knowledge	0.03	0.86		

Table 6.12. Satisfaction with online collaborative case-based learning module of participants in a medical nutrition therapy I class (N = 24*)

	Strongly Disagree n (%**)	Disagree n (%**)	Neither Agree nor Disagree n (%**)	Agree n (%**)	Strongly Agree n (%**)
The individual self-reflection raised my awareness of the knowledge, values, and experiences I brought to the case study.	0 (0)	1 (4)	4 (17)	12 (50)	7 (29)
The group discussions helped me think about additional information I did not initially consider.	0 (0)	1 (4)	2 (8)	13 (54)	8 (33)
The "first step" and "next step" dropbox assignments helped me apply information I learned in a practical way.	0 (0)	2 (8)	4 (17)	14 (58)	4 (17)
The "first step" and "next step" dropbox assignments helped me complete the final group assignment.	0 (0)	0 (0)	6 (25)	10 (42)	8 (33)
The final group assignment helped me develop skills I would use in practice.	0 (0)	0 (0)	2 (8)	15 (63)	7 (29)
The self-evaluation helped me assess what I learned.	0 (0)	2 (8)	4 (17)	12 (50)	6 (25)
I feel confident in my skills to address obesity in a similar situation.	0 (0)	0 (0)	1 (4)	19 (79)	4 (17)
I feel confident in my skills to find credible information about obesity prevention and treatment.	0 (0)	0 (0)	2 (8)	17 (71)	5 (21)
The case study was easy to navigate on eLC.	1 (4)	6 (25)	4 (17)	11 (46)	2 (8)
The length of time between parts of the case study was adequate.	1 (4)	6 (25)	4 (17)	12 (50)	1 (4)
The variety of activities contributed to my learning.	0 (0)	2 (8)	4 (17)	14 (58)	4 (17)
It was easy to work with my online group.	0 (0)	5 (21)	9 (38)	7 (29)	3 (13)
The expectations for each part of the case study were clear.	1 (4)	5 (21)	4 (17)	12 (50)	2 (8)
Group activities contributed to my learning.	0 (0)	4 (17)	7 (29)	10 (42)	3 (13)
The case study should be an individual assignment.	0 (0)	9 (38)	4 (17)	6 (25)	5 (21)

* All students who completed student satisfaction survey were included in analysis
**Percentages may not sum to 100 due to rounding

Table 6.13: Satisfaction with online collaborative case-based learning module of participants in a clinical nutrition interventions class (N = 22*)

	Strongly Disagree n (%**)	Disagree n (%**)	Neither Agree nor Disagree n (%**)	Agree n (%**)	Strongly Agree n (%**)
The individual self-reflection raised my awareness of the knowledge, values, and experiences I brought to the case study.	0 (0)	0 (0)	9 (41)	11 (50)	2 (9)
The group discussions helped me think about additional information I did not initially consider.	0 (0)	2 (9)	3 (14)	13 (59)	4 (18)
The group dropbox assignments helped me apply information I learned in a practical way.	0 (0)	0 (0)	8 (36)	12 (55)	2 (9)
The group dropbox assignments helped me complete the final group assignment.	0 (0)	1 (5)	8 (36)	12 (55)	1 (5)
The final group assignment helped me develop skills I would use in practice.	0 (0)	1 (5)	5 (23)	15 (68)	1 (5)
The self-evaluation helped me assess what I learned.	0 (0)	0 (0)	7 (32)	10 (46)	5 (23)
I feel confident in my skills to address obesity in a similar situation.	0 (0)	0 (0)	4 (18)	16 (73)	2 (9)
I feel confident in my skills to find credible information about obesity prevention and treatment.	0 (0)	0 (0)	2 (9)	16 (73)	4 (18)
The case study was easy to navigate on eLC.	0 (0)	11 (50)	7 (32)	3 (14)	1 (5)
The length of time between parts of the case study was adequate.	0 (0)	5 (23)	5 (23)	10 (46)	2 (9)
The variety of activities contributed to my learning.	0 (0)	0 (0)	6 (27)	14 (64)	2 (9)
It was easy to work with my online group.	0 (0)	7 (32)	3 (14)	10 (46)	2 (9)
The expectations for each part of the case study were clear.	0 (0)	2 (10)	2 (10)	14 (67)	3 (14)
Group activities contributed to my learning.	0 (0)	0 (0)	8 (36)	13 (59)	1 (5)
The case study should be an individual assignment.	0 (0)	5 (25)	6 (30)	8 (40)	1 (5)

*All students who completed student satisfaction survey were included in analysis
**Percentages may not sum to 100 due to rounding

Figure 6.1. Students' perception of learning about nutrition assessment for obesity in an online collaborative case-based learning module in a medical nutrition therapy I class

Figure 6.2. Students' perception of learning about nutrition counseling for obesity in an online collaborative case-based learning module in a clinical nutrition interventions class

CHAPTER 7

DISCUSSION AND IMPLICATIONS FOR FUTURE RESEARCH

This study tested the effectiveness of four online, collaborative case-based learning modules that were designed to scaffold students' learning through provision of small pieces of information about the case and supplemental content relevant to the case over the course of three weeks. Students were asked to consider guiding questions and post their thoughts about what they knew and what they needed to know about the case. Students also engaged in group activities, such as creating educational materials for clients, completing nutrition assessment forms, and develop a persuasive presentation to engage stakeholders in school wellness policy revision. The following discussion will highlight the overall findings from the online collaborative case-based learning modules, as well as key challenges and implications and recommendations for future research.

Summary of Findings

Overall, results were mixed regarding the effect of these modules on students' knowledge and skills about obesity prevention and treatment. There was a significant change in score from pre-test to post-test in the general life cycle nutrition class and for the online group in the medical nutrition therapy I class. In both classes, the online module was more effective for students who scored below the mean on the pre-test, which may illustrate a closing of the knowledge gap for these students.

During spring semester, there was not a significant difference in change in score for the online versus paper-based case study group in the clinical nutrition interventions class, nor a

significant change in score for students in the community nutrition class. However, students in both classes expressed gaining knowledge about the case study objectives and viewed the learning experience as positive based on the student satisfaction surveys.

Overall, students participating in the four modules were satisfied with the content of the modules. Many expressed in focus groups and self-evaluation of learning essays that they appreciated the realistic nature of the cases and planned to use information that they learned in their own lives. However, technological and logistical issues were more problematic for students. Some of the difficulties may be related to a change in learning management system during the course of the study. Students in the first focus group expressed that they did not regularly check the learning management system for updates. Also, some students found it difficult to coordinate group work with an online group while other utilized outside resources, such as Google® Docs and Facebook® groups, to coordinate work.

Most of the students expressed in the satisfaction survey that group discussions helped them consider new information, as their peers had different experiences and perspectives. Although several students believed that the case studies should be individual, they appreciated learning from their peers. However, students expressed some frustration with group members who were not contributing to the work.

Challenges

Designing learning modules for the online environment. "Learning by design," or active learning, is important for developing students' knowledge and skills, and learning activities should be designed to engage students in practical experiences,[1] as students learning best in an active learning environment.[2] One of the challenges for any course developer, especially for online courses, is determining how to create an environment that supports learning through an

engaging, enriching experience while being "user-friendly." In the present study, we used a relatively "low-tech" approach through utilizing PowerPoint® documents and other files to provide information to students, as well as provided links to external web sites. However, setting up the materials in a logical way in the learning management system can be a challenge. Ideally, a course developer would collaborate with a team of experts in educational design and instructional technology to determine the best platform and system for delivery of materials for "drip-feeding" (ie, content is automatically released over time, either based on regular intervals or completion of a task). Students in the medical nutrition therapy I class appreciated the "blog" because "it seemed like the client was a real person." Additionally, students in the community nutrition class enjoyed the link to a YouTube® video about a teacher who integrated yoga and gardening into her kindergarten classroom. It is important to determine from the beginning which types of media, materials, and activities most contribute to student learning in order to build the experience around learning.[3] Puri et al[4] utilized a series of interactive online videos to teach students about nutrition counseling principles. The researchers showed a small but significant change in knowledge from pre-test to post-test, although the significance was likely related to the larger sample size. Our study showed a small but significant change in knowledge after participating in an online case-based learning module in two classes. So, it may not be necessary to develop sophisticated video tutorials or other materials to engage students in learning. However, it is important to determine how students will access information and complete activities in order to design a learning environment that is most beneficial for their learning.

Encouraging student collaboration. Another challenge in this project was facilitating group work, especially in the larger class. Although the project was designed to be completed online, with resources for group communication (ie, e-mail, group discussion board), several

students noted that it was difficult to work with students whom they did not know. In addition, several students expressed difficulty ensuring that all group members contributed to the group projects, with many completing assignments individually and submitting to the dropbox before the project was reviewed by the group. Undergraduate students may benefit from guidance in working with groups, setting group expectations and establishing accountability structures. An instructor may also encourage students to share with each other what works best for coordinating activities and collaborating on projects. For example, one group in the clinical nutrition interventions class used a private Facebook® group to facilitate communication. Other groups may be able to utilize the same technology if aware of best practices.

Instructor time in online case-based learning modules. Another challenge is the investment of time for an instructor or teaching assistant to develop and facilitate an online case-based learning module. As with any case study or course, developers must invest time to determine the learning objective and then design questions or activities to ensure that students meeting the learning objective. With a traditional paper-based case study, an instructor likely researches a variety of cases to develop a "conglomeration" case with a written scenario of the client, medical information, and nutrition information. The instructor then develops a list of questions to guide the students in understanding the case and determining the best intervention. The instructor may provide a list of resources, as well. In an online case study module, the instructor has the additional time investment of developing supplemental materials (i.e., PowerPoint® slides, simulated documents, video or audio recordings, etc.) and uploading materials and resource links to the web site or learning management system. Once the online case-based learning module is implemented, instructors or teaching assistants should interact frequently with students through discussion boards and providing feedback for projects. While

each project or discussion board posting is likely shorter than a completed paper-based case study, the increased frequency of contact may require more time for facilitation than grading a traditional case study. However, the opportunity to interact with all students – especially those who may be less likely to speak in class – outweighs the time investment of this format. Students also mentioned in focus groups their appreciation of interacting with the instructor and receiving personalized feedback.

Evaluating effectiveness using knowledge tests. One of the questions that this study hoped to answer was, "Is an online collaborative case-based learning module effective in increasing knowledge about obesity prevention and treatment?" As with other studies, results were mixed.[5,6] A possible explanation is the use of "knowledge tests" for a domain that is skill-oriented. The mean for the pre-test scores in all classes was over 50%, which indicates that students had some knowledge about obesity-related topics before beginning the case study modules. It is possible that some students guessed on multiple-choice questions; however, scores would likely not be as high with increased random guessing. Although the short-answer questions were designed to be application-oriented, they may not have been the best indicators of skills gained. Litchfield et al[6,7] suggested that "key feature exams" may be a better marker of change in performance.

Implications and Recommendations for Future Research

External web site delivery of case study. One of the greatest challenges in this project was the change in learning management systems. Students expressed difficulty working with the new system, especially finding where materials were posted. A possible solution is to develop an external online collaborative case-based learning web site with a user portal. With an external site, the course designer has control over how the case study looks and functions, as well as how and when users access the information. In addition, the web site can be integrated with e-mail

lists (ie, MailChimp®), which could facilitate reminder e-mails to students about what is due. However, such a platform may require a significant investment for development, especially as web site and instructional technology designers will be required. A benefit of such a system, however, is that it could be developed by and shared with multiple institutions – which may decrease the cost per institution.

Automation of feedback. It is possible to set up automatic grading rubrics and feedback in most learning management systems. These features usually rely on students entering key words or phrases that trigger a feedback response. An external web site, connected to an e-mail list-serv, also allows instructors to setup automatic feedback mechanisms, such as thanking the student for submitting an assignment. Automation of feedback can decrease the time investment of the instructor for routine activities in the module; however, it should not be used for all tasks, as students appreciate the personalized attention afforded by the online module.

Allowing for extended follow-up of participants. One of the interesting findings from the online collaborative case-based learning modules was that many students recognized a connection between the case study family and their own families. In all four classes, several students noted intent to change their own behavior. Because it is difficult to measure "change in knowledge" related to participation in the online learning modules as an outcome, a more important outcome may be behavioral change. A "next step" study should include not only an assessment of baseline knowledge through a pre-test but also baseline behaviors, such as average daily minutes of physical activity, intake of fruits and vegetables, and participant weight/BMI, and then track changes over six to twelve months. While students may not necessarily retain "knowledge," they may change behavior, which would be a more important outcome for obesity

prevention and treatment. An additional component to study may be to conduct follow-up interviews to determine how students used or shared what they learned in the case study modules, if at all.

Final Thoughts

The purpose of this study was to determine the effectiveness of an innovative online collaborative case-based learning module on students' knowledge and skills related to obesity prevention and treatment. Although the current study did not show large gains in knowledge in the online groups, students participating in the online groups did not decrease in score at post-test. Therefore, online case-based learning modules are at least as effective as paper-based case studies. Overall, students enjoyed their experience in the modules, and several suggested additional topics to explore through similar modules. Future researchers should explore developing modules about other clinical disease states and nutrition-related topics. In designing these modules, researchers should investigate alternative platforms that may be more acceptable to students. Finally, researchers should investigate the relationship between participation in such online collaborative case-based learning modules and behavior change or advocacy efforts to address obesity-related policies, which may be a more important outcome for obesity prevention and treatment.

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APPENDICES

APPENDIX A

CONSENT FORM AND RECRUITMENT SCRIPTS FOR FDNS 2100 BASELINE SURVEY

Consent Form

Dear FDNS 2100 Student:

Thank you for your interest in our research project entitled, "Obesity Risk Knowledge of Students Enrolled in Introductory Foods and Nutrition Courses." The purpose of this study is to understand what students know about health risks associated with obesity prior to completing FDNS 2100. Ultimately, this study will provide valuable information as we develop educational modules to facilitate learning about obesity prevention and treatment in several Foods and Nutrition courses.

To take part in this survey, you must be 18 years of age or older and currently enrolled in FDNS 2100. Students who are auditing the class are not eligible to participate.

Taking part in the survey will involve answering questions about health risks associated with obesity, as well as demographic questions to help us understand the diversity of students in our classes. The survey should take about fifteen minutes to complete. Being in the study is voluntary, and you may choose not to take part or stop at any time without penalty to your class grade. If you decide not to participate in this survey, you may complete a designated alternative assignment for extra class credit.

Since the survey is internet-based, it is important to understand that internet communications are not always secure and there is a limit to the confidentiality that can be guaranteed due to the technology itself. However, once the survey responses are received, you will remain anonymous. The results of the survey may be published, but your name will not be used. Findings from this project will be presented in summary form only.

The findings from this study will provide information about what students know about health risks associated with obesity. These findings will assist us in developing educational modules to meet the needs of future students in FDNS 2100. There are no known risks or discomforts associated with this research.

If you have any questions about this survey, please feel free to contact Dr. Joan Fischer (706-542-7983) or send e-mail to jfischer@fcs.uga.edu. Questions or concerns about your rights as a research participant should be directed to the Chairperson, University of Georgia Institutional Review Board, 612 Boyd GSRC, Athens, Georgia 30602-7411; telephone (706) 542-3199; email address irb@uga.edu.

By clicking YES (I agree to participate in this survey) below, you are agreeing to participate in the above described survey project.

Thank you for your consideration. Please print and keep this letter for your records.

Sincerely,
Joan G. Fischer, PhD, RD, LD, Associate Professor of Foods and Nutrition

Initial Recruitment Script

Good morning/afternoon/evening,

My name is [Joan Fischer or Whitney Bignell]. I would like to invite you to participate in a survey study about health risks associated with obesity. The purpose of this study is to determine what students in FDNS 2100 already know about health risks associated with obesity in order to develop educational materials to better suit your needs. This study is voluntary, so you are not required to participate, and your participation will not affect your current or future standing in this class. Dr. [Name of Professor] is offering extra credit for participating. However, you may also choose to do the alternative extra credit assignment instead of participating in this survey. If you would like to participate, please let Dr. [Name of Professor] know so that I can send you a link to the survey through eLC mail. Please let me know if you have any questions. Thank you for your time today!

Initial Recruitment E-mail

Dear Students,

One of our faculty, Dr. Fischer, would like to invite you to participate in a survey study to determine what students in FDNS 2100 know about the health risks associated with obesity. The purpose of this study is to determine what students in FDNS 2100 already know about health risks associated with obesity in order to develop educational materials to better suit your needs. This study is voluntary, so you are not required to participate, and your participation will not affect your current or future standing in this class. I am offering extra credit for participating. However, you may also choose to do the alternative extra credit assignment instead of participating in this survey. If you would like to participate, please let me know so that I can send you a link to the survey through eLC mail. Please let me know if you have any questions. Thank you!

Sincerely,

Dr. [Professor's name]

Follow-up Recruitment E-mail

Dear Students,

It's not too late to participate in the online survey about health risks associated with obesity. As a reminder, the purpose of this study is to determine what students in FDNS 2100 already know about health risks associated with obesity in order to develop educational materials to better suit your needs. This study is voluntary, so you are not required to participate, and your participation will not affect your current or future standing in this class. I am offering extra credit for participating. However, you may also choose to do the alternative extra credit assignment instead of participating in this survey. If you would like to participate, please let me know so that I can send you a link to the survey through eLC mail. Please let me know if you have any questions. Thank you!

Sincerely,

Dr. [Professor's name]

APPENDIX B

CONSENT FORM AND RECRUITMENT SCRIPT FOR FDNS 4050 AND FDNS 4540

(ONLINE CONSENT FORM)

Consent Form

You are being invited to participate in a research study entitled An Online Collaborative Case-Based Learning Approach to Obesity Prevention and Treatment. This research hopes to find out how a collaborative online case study module impacts students' knowledge, skills, and attitudes towards obesity prevention and treatment, as well as determine the acceptability of such an approach. In FDNS 4050 or FDNS 4540, you will complete an online collaborative case study module. You will receive full credit for completing this module.

If you agree to participate in the study, you will be asked to provide permission for the researcher to analyze documents related to the course case study. These include:

- An online pre-test approximately one week before beginning the case study and an online post- test approximately one week after completing the case study. The pre-test and post-test will include both knowledge and application questions based on the objectives of the case study.
- Online case study module
- Personal reflection (i.e., what are your experiences related to the topic of interest, such as what was your weight status as a child and how did you talk about weight, what is your experience with behavior change, what is a family member's or friend's experience with chronic disease)
- Self-evaluation (i.e., what did you learn in this module, what do you need to learn more about, how will you use what you learned in practice)
- Discussion board postings
- Group assignments
- Student satisfaction survey

For the personal reflection and self-evaluation, you may write as generally as you want, or you may decline to submit these reflections if you are uncomfortable with the topic. The student satisfaction survey will ask for your perception of learning and group work in the online case study module.

Your participation, of course, is voluntary but would be greatly appreciated. Dr. Anderson is offering extra credit if you participate in the study. However, you may choose not to participate or to withdraw your consent at any time without penalty or loss of benefits to which you are otherwise entitled, and you may complete the alternative extra credit assignment. The alternative extra credit assignment is to e-mail a link to an obesity-related article from the popular press (i.e., New York Times, USA Today, NPR, etc.) to Whitney Bignell (web1975@uga.edu). If you agree to the use of your information/data for this research project, please simply click "Yes, I agree to participate in this study" below; if you don't agree, none of your data will be included in the research and you can still complete the case study to meet your course requirement. If you decide to withdraw from the study, the information that can be identified as yours will be kept as part of the study and may continue to be analyzed, unless you make a written request to remove, return, or destroy the information.

The results of the research study may be published, but your name or any identifying information will not be used. In fact, the published results will be presented in summary form only. All data

obtained from you will be linked to your University of Georgia MyID and/or e-mail address. To maintain confidentiality, your personal identifier will be recoded to a participant number in transcripts of discussion board postings and personal reflections, and original documents will be destroyed/deleted from the computer system. Pre-test/post-test scores will be reported in aggregate, and any identifying information in the raw data will be recoded to a participant number. The project's research records may be reviewed by departments at the University of Georgia responsible for regulatory and research oversight. Researchers will not release identifiable results of the study to anyone other than individuals working on the project without your written consent unless required by law. There are no known risks associated with this research. To minimize risks of discomfort, you may abstain from submitting personal reflection assignments, and you may request in writing that your responses on the discussion board be deleted from transcripts and not considered in analysis. Potential benefits from participating in this study include gains in knowledge and skills related to nutrition and obesity prevention/treatment. In addition, the findings from this project may help your instructors design more effective group learning projects for nutrition students.

The researchers conducting this study are: Dr. Joan G. Fischer, an associate professor in the Department of Foods and Nutrition, and Whitney Bignell, a graduate student in the same department. You may ask any questions you have now by e-mailing Whitney Bignell at web1975@uga.edu. If you have questions later, you are encouraged to contact Dr. Fischer at 706- 542-7983 or jfischer@fcs.uga.edu.

Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 629 Boyd GSRC, Athens, Georgia 30602-7411; telephone (706) 542-3199; email address irb@uga.edu.

Research Subject's Consent to Participate in Research:

To voluntarily agree to take part in this study, you must choose an option below. By clicking on "Yes, I agree to participate in this study," you indicate that you have read or had read to you this entire consent form, and have had all of your questions answered.

- Yes, I agree to participate in this study.

- No, I do not agree to participate in this study. Please delete or destroy all information related to my case study.

Recruitment Script

Good morning/afternoon,

My name is Whitney Bignell, and I am a doctoral student in the Department of Foods and Nutrition. As part of my research, I am looking at an online approach to help students learn about obesity prevention and treatment. I would like to invite you to participate in this study entitled "An Online Collaborative Case-Based Learning Approach to Obesity Prevention and Treatment." The purpose of this study is to examine how a collaborative online case-based learning module impacts students' knowledge, skills, and attitudes related to nutrition and obesity prevention and treatment.

If you agree to participate in the study, you will be asked to provide permission for documents related to the course case study to be analyzed by future graduate students and me. These documents include:

- An online pre-test approximately one week before beginning the case study and an online post-test approximately one week after completing the case study. The pre-test and post-test will include both knowledge and application questions based on the objectives of the case study.
- Personal reflection (i.e., what are your experiences related to the topic of interest, such as what was your weight status as a child and how did you talk about weight, what is your experience with behavior change, what is a family member's or friend's experience with chronic disease)
- Self-evaluation (i.e., what did you learn in this module, what do you need to learn more about, how will you use what you learned in practice)
- Discussion board postings
- Group assignments
- Student satisfaction survey
- For the personal reflection and self-evaluation, you may write as generally as you want, or you may decline to submit these reflections if you are uncomfortable with the topic. The student satisfaction survey will ask for your perception of learning and group work in the online case study module.

This study is voluntary, so you are not required to participate, and your participation will not affect your current or future standing in this class. All of your information will be de-identified before analysis to maintain confidentiality.

If you would like to participate, allowing me to collect data from your case study, please read the consent form that is the first question on the online pre-test and select, "Yes, I agree to participate in this study." If you do not want to have your information included in the study, you will complete the case study as part of your course requirement; however, no data will be collected from your case study. Please let me know if you have any questions. Thank you!

APPENDIX C

CONSENT FORM AND RECRUITMENT SCRIPT FOR FDNS 4500 AND FDNS 4520

(SIGNED CONSENT FORM)

Consent Form

You are being invited to participate in a research study entitled An Online Collaborative Case-Based Learning Approach to Obesity Prevention and Treatment. This research hopes to find out how a collaborative online case study module impacts students' knowledge, skills, and attitudes towards obesity prevention and treatment, as well as determine the acceptability of such an approach. In FDNS 4500 and FDNS 4520, you will participate in one traditional paper-based case study and one online collaborative case study module as part of your required coursework. In FDNS 4500, you will be randomly assigned to complete either the traditional paper-based case study or the online collaborative case study module; in FDNS 4520, you will complete a case study using the alternative format. You will receive full credit for completing the paper-based case study or the online collaborative module.

If you agree to participate in the study, you will be asked to provide permission for the researcher to analyze documents related to the course case study. These include:

- An online pre-test approximately one week before beginning the case study and an online post-test approximately one week after completing the case study. The pre-test and post-test will include both knowledge and application questions based on the objectives of the case study.
- When you participate in the online case study module:
    - Personal reflection (i.e., what are your experiences related to the topic of interest, such as what was your weight status as a child and how did you talk about weight, what is your experience with behavior change, what is a family member's or friend's experience with chronic disease)
    - Self-evaluation (i.e., what did you learn in this module, what do you need to learn more about, how will you use what you learned in practice)
    - Discussion board postings
    - Group assignments
    - Student satisfaction survey
- For the personal reflection and self-evaluation, you may write as generally as you want, or you may decline to submit these reflections if you are uncomfortable with the topic. The student satisfaction survey will ask for your perception of learning and group work in the online case study module.

Your participation, of course, is voluntary but would be greatly appreciated. You may choose not to participate or to withdraw your consent at any time without penalty or loss of benefits to which you are otherwise entitled. If you agree to the use of your information/data for this research project, please simply sign on the line below; if you don't agree, none of your data will be included in the research and there will be no impact on your participation in the course. If you decide to withdraw from the study, the information that can be identified as yours will be kept as part of the study and may continue to be analyzed, unless you make a written request to remove, return, or destroy the information.

The results of the research study may be published, but your name or any identifying information will not be used. In fact, the published results will be presented in summary form only. All data

obtained from you will be linked to your University of Georgia MyID and/or e-mail address. To maintain confidentiality, your personal identifier will be recoded to a participant number in transcripts of discussion board postings and personal reflections, and original documents will be destroyed/deleted from the computer system. Pre-test/post-test scores will be reported in aggregate, and any identifying information in the raw data will be recoded to a participant number. The project's research records may be reviewed by departments at the University of Georgia responsible for regulatory and research oversight. Researchers will not release identifiable results of the study to anyone other than individuals working on the project without your written consent unless required by law. There are no known risks associated with this research. To minimize risks of discomfort, you may abstain from submitting personal reflection assignments, and you may request in writing that your responses on the discussion board be deleted from transcripts and not considered in analysis. Potential benefits from participating in this study include gains in knowledge and skills related to nutrition and obesity prevention/treatment. In addition, the findings from this project may help your instructors design more effective group learning projects for nutrition students.

The researchers conducting this study are: Joan G. Fischer, an associate professor in the Department of Foods and Nutrition, and Whitney Bignell, a graduate student in the same department. You may ask any questions you have now. If you have questions later, you are encouraged to contact Dr. Fischer at 706-542-7983 or jfischer@fcs.uga.edu.

Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 629 Boyd GSRC, Athens, Georgia 30602-7411; telephone (706) 542-3199; email address irb@uga.edu.

Research Subject's Consent to Participate in Research:
I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

_____	_____	_____
Name of Researcher	Signature	Date
_____	_____	_____
Name of Participant	Signature	Date

Please sign both copies, keep one and return one to the researcher.

Recruitment Script

Good morning/afternoon,

My name is Whitney Bignell, and I am a doctoral student in the Department of Foods and Nutrition. As part of my research, I am looking at an online approach to help students learn about obesity prevention and treatment. I would like to invite you to participate in this study entitled "An Online Collaborative Case-Based Learning Approach to Obesity Prevention and Treatment." The purpose of this study is to examine how a collaborative online case-based learning module impacts students' knowledge, skills, and attitudes related to nutrition and obesity prevention and treatment.

In FDNS 4500 and FDNS 4520, you will participate in one traditional paper-based case study and one online collaborative case study module as part of your required coursework. In FDNS 4500, you will be randomly assigned to complete either the traditional paper-based case study or the online collaborative case study module; in FDNS 4520, you will complete a case study using the alternative format. In the online format, you will be assigned to groups of 5-8 students, and the case study will be delivered over the course of three weeks. In the paper-based format, you will work in groups, as well, but submit your answers individually. You will also have three weeks to complete the case study. You will receive full credit for completing the paper-based case study or the online collaborative module.

If you agree to participate in the study, you will be asked to provide permission for documents related to the course case study to be analyzed by future graduate students and me. These documents include:

- An online pre-test approximately one week before beginning the case study and an online post-test approximately one week after completing the case study. The pre-test and post-test will include both knowledge and application questions based on the objectives of the case study.
- When you participate in the online case study module, you will complete the following:
    - Personal reflection (i.e., what are your experiences related to the topic of interest, such as what was your weight status as a child and how did you talk about weight, what is your experience with behavior change, what is a family member's or friend's experience with chronic disease)
    - Self-evaluation (i.e., what did you learn in this module, what do you need to learn more about, how will you use what you learned in practice)
    - Discussion board postings
    - Group assignments
    - Student satisfaction survey
- For the personal reflection and self-evaluation, you may write as generally as you want, or you may decline to submit these reflections if you are uncomfortable with the topic. The student satisfaction survey will ask for your perception of learning and group work in the online case study module.

This study is voluntary, so you are not required to participate, and your participation will not affect your current or future standing in this class. All of your information will be de-identified before analysis to maintain confidentiality.

If you would like to participate, allowing me to collect data from your case study, please read the consent form that is circulating now and sign both copies. Keep one copy for yourself and give one copy to Dr. Fischer before you leave today. If you do not want to have your information included in the study, you will complete the case study as part of your course requirement; however, no data will be collected from your case study. Please let me know if you have any questions. Thank you!

APPENDIX D

CONSENT FORM, RECRUITMENT SCRIPT, AND INTERVIEW PROTOCOL FOR FDNS 4500 PRE-MODULE FOCUS GROUP

UNIVERSITY OF GEORGIA
CONSENT FORM

An Online Collaborative Case-Based Learning Approach to Obesity Prevention and Treatment

Researcher's Statement

We are asking you to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. This form is designed to give you the information about the study so you can decide whether to be in the study or not. Please take the time to read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information. When all your questions have been answered, you can decide if you want to be in the study or not. This process is called "informed consent." A copy of this form will be given to you.

Principal Investigator: *Joan Fischer, PhD, RD, LD*
Department of Foods and Nutrition
390 Dawson Hall
305 Sanford Drive
Athens, Georgia 30602
(706) 542-7983
jfischer@fcs.uga.edu

Purpose of the Study

The purpose of this study is to examine how a collaborative online case-study module impacts students' knowledge, skills, and attitudes towards obesity prevention and treatment, as well as determine the acceptability of using this learning approach. Specifically for this focus group, we hope to learn how students perceive and manage group work, as well as experiences with case studies. You are being asked to participate because you are a student currently enrolled in FDNS 4500.

Study Procedures

If you agree to participate, you will be asked to …

- *Respond to questions posed by the focus group moderator related to your past experiences with small group projects.*
- *Commit approximately one hour of your time.*
- *The moderator will ask questions about your favorite class project, the barriers and facilitators to working in a group, and how you have managed group work in the past. You may abstain from responding to any question if you would prefer not to answer.*
- *This focus group session will be audiotaped and transcribed verbatim. However, all identifying information will be deleted from the transcript, and the audio file will be destroyed after transcription.*

Risks and discomforts

- *We do not anticipate any risks from participating in this research.*
- *To minimize risks of discomfort, you may abstain from answering any question, and you may leave the focus group at any time.*

Benefits

- *There are no direct benefits to be received from participating in this focus group.*
- *Expected benefits to education from this research include being able to design more effective group learning projects for nutrition students.*

Incentives for participation

There is no incentive for being in the study.

Audio/Video Recording

This focus group session will be audiotaped and transcribed verbatim. The audio file will then be erased/deleted. Transcription of the session is necessary for the researcher to take into account all of the opinions shared and ensure the accuracy of the notes taken during the session.

Privacy/Confidentiality

Data collected from you will not include personally identifiable information. The only record of your participation in this focus group study is this signed consent form, which will not be connected to your responses during the focus group. You will be provided with a participant number to introduce yourself for voice recognition in transcription purposes only. In addition, all participants will be asked to not discuss the proceedings of this focus group (i.e., topics discussed, participants in attendance, etc.) outside of this focus group. The project's research records may be reviewed by departments at the University of Georgia responsible for regulatory and research oversight.

Researchers will not release identifiable results of the study to anyone other than individuals working on the project without your written consent unless required by law.

Taking part is voluntary

Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled.

If you decide to withdraw from the study, the information that can be identified as yours will be kept as part of the study and may continue to be analyzed, unless you make a written request to remove, return, or destroy the information.

If you have questions
The main researchers conducting this study are *Dr. Joan G. Fischer*, an associate professor in the Department of Foods and Nutrition and *Whitney Bignell*, a graduate student in the same department at the University of Georgia. Please ask any questions you have now. If you have questions later, you may contact Dr. Fischer at jfischer@fcs.uga.edu or at (706) 542-7983. If you have any questions or concerns regarding your rights as a research participant in this study, you may contact the Institutional Review Board (IRB) Chairperson at 706.542.3199 or irb@uga.edu.

Research Subject's Consent to Participate in Research:
To voluntarily agree to take part in this study, you must sign on the line below. Your signature below indicates that you have read or had read to you this entire consent form, and have had all of your questions answered.

_____	_____	_____
Name of Researcher	Signature	Date
_____	_____	_____
Name of Participant	Signature	Date

Please sign both copies, keep one and return one to the researcher.

Pre-module Focus Group Announcement

Dear Students,

One of our graduate students, Whitney Bignell, would like to invite you to participate in a focus group study to learn about your experiences with case studies and collaborative learning. The purpose of this focus group is to explore how students in advanced nutrition classes approach collaborative learning and case studies. This study is voluntary, so you are not required to participate, and your participation will not affect your current or future standing in this class. The focus groups will be held on Tuesday, September 3rd at 6:00 p.m. in Dawson Hall, Rm. 216 and Thursday, September 5th at 11:00 a.m. in Dawson Hall, Rm. 264. If you would like to participate, please e-mail Whitney (web1975@uga.edu) your preferred time so that she can add you to the roster. Groups are limited to 12 participants, and they will be filled on a first-come, first-serve basis based on your e-mail response. Please let me know if you have any questions. Thank you!

Sincerely,

Dr. Fischer

Interview Protocol for Pre-module Focus Group

Moderator: Thank you for being here to share you perspective related to collaborative learning in nutrition courses. The purpose of this focus group is to explore how students in advanced nutrition classes approach collaborative learning and case studies. I want to remind you that your conversations will be recorded and transcribed verbatim but that your name will not be identified in the transcripts. You have been given a number and will be asked to answer the first question by introducing yourself by this number only so that your voice can be identified for transcription purposes as Participant #1, for example. Any other identifying information will be altered in the transcripts, as well. You may refrain from responding to any question, and you may withdraw from this focus group at any time. To protect everyone's opinions and ensure open conversation, I also ask that you keep what is discussed in this focus group confidential and do not share with others outside of this group, nor report who was involved in this focus group. Do you have any questions at this time?

[Moderator answers any questions that may arise]

Collaborative learning

1. I want to start by asking each of you what has been your favorite class so far, and what did you like about the class?
2. What makes a class successful for you?
3. What makes a class difficult for you?
4. I want to move our discussion to the concept of collaborative or group learning. What comes to mind when I say "group project"?
5. What makes a group project enjoyable?
6. What makes a group project difficult?
7. Think about a specific group project – how did you manage getting the work done?
8. What kinds of roles have you assigned in group projects? (Examples include deciding who is leader, note-taker, reporter)
9. What are important "ground rules" to have when working in a group?
10. How have you or would you handle a group member who was not contributing their part?
11. How do you ensure that you are learning in a group project?
12. How would you assess if your group project was successful?
13. If you had one group project to do over, what would you do differently?
14. Is there anything else you would like to share with me about working in groups?

Case Studies

1. What comes to mind when I say "case study"?
2. How have you used case studies in your classes?
3. What makes a good "case study"?
4. How do case studies support your learning?
5. What problems have you encountered with case studies?

Moderator: Thank you so much for your participation today. I want to remind you that your responses will remain confidential. I ask that you also keep any information shared here amongst yourselves. I appreciate your perspectives!

APPENDIX E

POST-MODULE CONSENT FORM, RECRUITMENT SCRIPT, AND INTERVIEW PROTOCOL FOR FDNS 4500 AND FDNS 4520 POST-MODULE FOCUS GROUPS

UNIVERSITY OF GEORGIA
CONSENT FORM

An Online Collaborative Case-Based Learning Approach to Obesity Prevention and Treatment

Researcher's Statement

We are asking you to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. This form is designed to give you the information about the study so you can decide whether to be in the study or not. Please take the time to read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information. When all your questions have been answered, you can decide if you want to be in the study or not. This process is called "informed consent." A copy of this form will be given to you.

Principal Investigator: *Joan Fischer, PhD, RD, LD*
Department of Foods and Nutrition
390 Dawson Hall
305 Sanford Drive
Athens, Georgia 30602
(706) 542-7983
jfischer@fcs.uga.edu

Purpose of the Study

The purpose of this study is to examine how a collaborative online case-study module impacts students' knowledge, skills, and attitudes towards obesity prevention and treatment, as well as determine the acceptability of using this learning approach. Specifically for this focus group, we hope to learn about your experiences with participation in the online case-study module and how we can improve this module. You are being asked to participate because you completed the online case-study module in FDNS 4500 or FDNS 4520.

Study Procedures

If you agree to participate, you will be asked to …

- *Respond to questions posed by the focus group moderator related to your experiences and perceptions of the online case-study module, particularly what worked well and what can be improved to facilitate your learning.*
- *Commit approximately one hour of your time.*
- *The moderator will ask questions about your experience with the online learning module, which components helped your learning and which components hindered your learning, and how you managed working as a group. You may abstain from responding to any question if you would prefer not to answer.*
- *This focus group session will be audiotaped and transcribed verbatim. However, all identifying information will be deleted from the transcript, and the audio file will be destroyed after transcription.*

Risks and discomforts

- *We do not anticipate any risks from participating in this research.*
- *To minimize risks of discomfort, you may abstain from answering any question, and you may leave the focus group at any time.*

Benefits

- *There are no direct benefits to be received from participating in this focus group.*
- *Expected benefits to education from this research include being able to design more effective group learning projects for nutrition students.*

Incentives for participation

The instructor is offering extra credit for participating in the focus group. However, you may complete the alternative extra credit assignment, a 3-4 page summary of what worked well and what could be improved in your case study, if you do not want to participate in the focus group ***OR*** *if you completed the paper-based case study.*

Audio/Video Recording

This focus group session will be audiotaped and transcribed verbatim. The audio file will then be erased/deleted. Transcription of the session is necessary for the researcher to take into account all of the opinions shared and ensure the accuracy of the notes taken during the session.

Privacy/Confidentiality

Data collected from you will not include personally identifiable information. The only record of your participation in this focus group study is this signed consent form, which will not be connected to your responses during the focus group. You will be provided with a participant number to introduce yourself for voice recognition in transcription purposes only. In addition, all participants will be asked to not discuss the proceedings of this focus group (i.e., topics discussed, participants in attendance, etc.) outside of this focus group. The project's research records may be reviewed by departments at the University of Georgia responsible for regulatory and research oversight.

Researchers will not release identifiable results of the study to anyone other than individuals working on the project without your written consent unless required by law.

Taking part is voluntary

Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled.

If you decide to withdraw from the study, the information that can be identified as yours will be kept as part of the study and may continue to be analyzed, unless you make a written request to remove, return, or destroy the information.

If you have questions
The main researchers conducting this study are *Dr. Joan G. Fischer*, an associate professor in the Department of Foods and Nutrition and *Whitney Bignell*, a graduate student in the same department at the University of Georgia. Please ask any questions you have now. If you have questions later, you may contact Dr. Fischer at jfischer@fcs.uga.edu or at (706) 542-7983. If you have any questions or concerns regarding your rights as a research participant in this study, you may contact the Institutional Review Board (IRB) Chairperson at 706.542.3199 or irb@uga.edu.

Research Subject's Consent to Participate in Research:
To voluntarily agree to take part in this study, you must sign on the line below. Your signature below indicates that you have read or had read to you this entire consent form, and have had all of your questions answered.

_____	_____	_____
Name of Researcher	Signature	Date
_____	_____	_____
Name of Participant	Signature	Date

Please sign both copies, keep one and return one to the researcher.

Recruitment Script

Dear Students,

One of our graduate students, Whitney Bignell, would like to invite you to participate in a focus group study to learn about your experiences with the online case-study module. The purpose of this focus group is to explore what worked well and what can be improved in the case study module. This study is voluntary, so you are not required to participate, and your participation will not affect your current or future standing in this class. The instructor is offering extra credit for participating in the focus group. However, you may complete the alternative extra credit assignment, a 3-4 page summary of what worked well and what could be improved in your case study, if you do not want to participate in the focus group **OR** if you participated in the paper-based case study.

If you would like to participate, please e-mail Whitney (web1975@uga.edu) your available days/times during [range of dates to be determined] so that she can add you to the roster. The final dates/times/locations of the focus groups will be determined based on your response to the follow-up Doodle scheduling request. You will then be able to sign up for a session on eLC. Groups are limited to 12 participants, and they will be filled on a first-come, first-serve basis. There will be 3-6 sessions offered based on your response. Please let me know if you have any questions. Thank you!

Sincerely,

Dr. Fischer

Interview Protocol for Post-module Focus Groups

Moderator: Thank you for being here to share you perspective related to participation in the online learning module. The purpose of this focus group is to explore your experiences with the online collaborate learning module. I want to remind you that your conversations will be recorded and transcribed verbatim but that your name will not be identified in the transcripts. You have been given a number and will be asked to answer the first question by introducing yourself by this number only so that your voice can be identified for transcription purposes as Participant #1, for example. Any other identifying information will be altered in the transcripts, as well. You may refrain from responding to any question, and you may withdraw from this focus group at any time. To protect everyone's opinions and ensure open conversation, I also ask that you keep what is discussed in this focus group confidential and do not share with others outside of this group, nor report who was involved in this focus group. Do you have any questions at this time?

[Moderator answers any questions that may arise]

Perception of learning

1. I want to start by asking each of you what was something interesting that you learned in the module?
2. How would you have learned about that topic if you did not participate in the module?
3. What did you want to learn more about in the module?

Group collaboration process

1. What was it like working in a group?
    a. What did you do to manage working in a group online?
    b. How was it different working in an online group versus face-to-face?
2. What helped you work effectively in your group?
3. What made it difficult to work in your group or what were some of the challenges that you faced?
4. How did you deal with your challenges?
5. What did you learn in your group that you wouldn't have learned by yourself, if anything at all?

What worked well and what could be improved

1. What components of the module helped you learn most about obesity prevention and treatment?
2. What did you like, if anything, about the module?
3. What would you change about the module?
4. Is there anything else that you would like to share with me about your experiences with the module – what worked well and what could be improved?
5. What are other ways that you would like to learn about obesity prevention and treatment?

Moderator: Thank you so much for your participation today. I want to remind you that your responses will remain confidential. I ask that you also keep any information shared here amongst yourselves. I appreciate your perspectives!

APPENDIX F

FDNS 2100 MODIFIED OBESITY RISK KNOWLEDGE SURVEY

Knowledge of Obesity Health Risks Survey Instrument

Directions: Read each statement below carefully. Determine if the statement is TRUE or FALSE to the best of your knowledge, or your may answer DON'T KNOW.

1. Adults are considered obese if their body mass index (BMI) is 30 or greater.
   - True
   - False
   - Don't know
2. A person with a "beer gut" has an increased risk of getting diabetes.
   - True
   - False
   - Don't know
3. Obesity increases the risk of getting colon cancer.
   - True
   - False
   - Don't know
4. An obese person who gets diabetes needs to lose at least 40% of their body weight for clear health benefits.
   - True
   - False
   - Don't know
5. Obese people can expect to live as long as non-obese people.
   - True
   - False
   - Don't know
6. Obesity increases the risk of getting breast cancer after menopause.
   - True
   - False
   - Don't know

7. There is **no** major health benefit if an obese person who gets diabetes loses weight.
    - True
    - False
    - Don't know
8. Obesity does **not** increase the risk of developing high blood pressure.
    - True
    - False
    - Don't know
9. It is better for a person's health to have fat around the hips and thighs (pear-shaped) than around the stomach and waist (apple-shaped).
    - True
    - False
    - Don't know
10. Obesity increases the risk of getting a food allergy.
    - True
    - False
    - Don't know
11. Obesity increases the risk of infertility in women but not men.
    - True
    - False
    - Don't know
12. A woman who is obese prior to pregnancy is more likely to have an obese child.
    - True
    - False
    - Don't know
13. Excess weight gain during pregnancy is **not** associated with a child's risk of being obese.
    - True
    - False
    - Don't know

14. Overweight children are more likely to be even more obese adults.
    - True
    - False
    - Don't know
15. Obese children are **not** more likely to develop type 2 diabetes.
    - True
    - False
    - Don't know
16. Obese children are more likely to have asthma.
    - True
    - False
    - Don't know
17. Children with autism are more likely to be obese.
    - True
    - False
    - Don't know
18. Obesity increases a child's risk of getting gallstones.
    - True
    - False
    - Don't know
19. Excess body weight can affect the shape and strength of a child's bones.
    - True
    - False
    - Don't know
20. Obese children are more likely to have poor self-esteem, which often continues into adulthood.
    - True
    - False
    - Don't know

Health Benefits of Weight Control

Directions: Using the Likert scale below, select the answer that best represents your belief about each statement.

- Strongly Agree
- Agree
- Moderately Agree
- Neither Agree Nor Disagree
- Moderately Disagree
- Disagree
- Strongly Disagree

1. Obesity prevents a person from getting the most out of life.
    - Strongly Agree
    - Agree
    - Moderately Agree
    - Neither Agree Nor Disagree
    - Moderately disagree
    - Disagree
    - Strongly Disagree

2. An obese person needs more medical care.
    - Strongly Agree
    - Agree
    - Moderately Agree
    - Neither Agree Nor Disagree
    - Moderately disagree
    - Disagree
    - Strongly Disagree
3. People should maintain an ideal body weight for optimal health.
    - Strongly Agree
    - Agree
    - Moderately Agree
    - Neither Agree Nor Disagree
    - Moderately disagree
    - Disagree
    - Strongly Disagree

4. Losing weight would greatly improve obese people's health.
    - Strongly Agree
    - Agree
    - Moderately Agree
    - Neither Agree Nor Disagree
    - Moderately disagree
    - Disagree
    - Strongly Disagree
5. A person with an ideal bodyweight can lead a more active life.
    - Strongly Agree
    - Agree
    - Moderately Agree
    - Neither Agree Nor Disagree
    - Moderately disagree
    - Disagree
    - Strongly Disagree

6. Losing weight would decrease medical expenses for obese people.
    - Strongly Agree
    - Agree
    - Moderately Agree
    - Neither Agree Nor Disagree
    - Moderately disagree
    - Disagree
    - Strongly Disagree

Demographic Data: The following questions help us understand the diversity of students in our FDNS 2100 classes.

1. Gender
    a. Male
    b. Female
2. Race/ethnicity
    a. Asian
    b. Hispanic
    c. Non-Hispanic black
    d. Non-Hispanic white
    e. Other
    f. Prefer not to answer
3. Age (open response)

4. Year in college (i.e., first year, second year, graduate student)
    a. First year undergraduate
    b. Second year undergraduate
    c. Third year undergraduate
    d. Fourth year undergraduate
    e. Fifth year or beyond undergraduate
    f. Graduate student
    g. Other
5. Intended or Declared College Major (open response)

APPENDIX G

FDNS 4050 PRE-TEST/POST-TEST

Basic Knowledge

1. An adult is considered obese when his or her body mass index (BMI) is greater than or equal to _____.
    a. 20
    b. 25
    c. 30
    d. 35
    e. 40
2. The formula for calculating body mass index (BMI) is _____.
    a. Height (inches)/Weight (pounds)
    b. Height (inches)/(Weight (pounds) x Weight (pounds))
    c. (Height (centimeters) x Height (centimeters))/Weight (kilograms)
    d. Weight (kilograms)/(Height (meters) x Height (meters))
    e. Weight (kilograms)/Height (inches)
3. Kelly is 5'6" and weighs 175 lbs. Kelly's BMI category is _____.
    a. Underweight
    b. Normal weight
    c. Overweight
    d. Obese
    e. Extreme obesity
4. Roger is 5'8" and weighs 260 lbs. Roger's BMI category is _____.
    a. Underweight
    b. Normal weight
    c. Overweight
    d. Obese
    e. Extreme obesity
5. Obesity increases risk for all of the following chronic diseases and conditions except:
    a. Cardiovascular disease
    b. Type 2 diabetes
    c. Post-menopausal breast cancer
    d. Celiac disease
    e. Sleep apnea

Prenatal and Perinatal Obesity Risks

6. Women who are obese prior to pregnancy are more likely to:
    a. Have difficulty conceiving
    b. Develop gestational diabetes
    c. Develop preeclampsia
    d. All of the above
    e. B and C only

7. Amber is 5'4" and weighs 200 lbs. According to the Institute of Medicine Guidelines, how much weight should she gain during her singleton pregnancy?
    a. 5-10 lbs.
    b. 11 – 20 lbs.
    c. 21 – 30 lbs.
    d. 31 – 40 lbs.
    e. More than 40 lbs.
8. Obese women have an increased risk of delivering an infant who is:
    a. Large for gestational age
    b. Preterm
    c. Macrosomic
    d. All of the above
    e. A and C only
9. Obese women have an increased risk of all of the following EXCEPT:
    a. Cesarean delivery
    b. Postpartum anemia
    c. Stillbirth
    d. Birth defects
    e. Obese women have an increased risk for all of the above complications
10. Obese women are less likely to successfully breastfeed their infants due to which of the following factors?
    a. Difficulty with infant latching
    b. Increased likelihood of having a Cesarean delivery
    c. Decreased milk production
    d. All of the above
    e. A and B only

Childhood Obesity Risks and Definitions

11. Children who are obese are more likely to develop all of the following health conditions EXCEPT?
    a. Asthma
    b. Type 2 diabetes
    c. High blood pressure
    d. Food allergies
    e. Sleep apnea
12. If both parents of a child are obese, the child is _____ more likely to be obese.
    a. 25%
    b. 45%
    c. 60%
    d. 80%
    e. 95%

13. Children who are overweight or obese are more likely _____
    a. To become obese adults
    b. To develop cardiovascular disease
    c. To develop type 2 diabetes
    d. <u>All of the above</u>
    e. B and C only
14. Children who are overweight or obese are at increased risk for which of the following health problems?
    a. Gallstones
    b. Fatty liver disease
    c. Gastro-esophageal reflux (GERD)
    d. Joint problems
    e. <u>All of the above</u>
15. Approximately what percent of children in the United States are considered obese?
    a. 11%
    b. <u>17%</u>
    c. 22%
    d. 34%
    e. 45%
16. A child over the age of 2 years is considered obese if his or her body mass index (BMI) for age and gender is greater than or equal to the _____.
    a. 50^{th} %ile
    b. 75^{th} %ile
    c. 85^{th} %ile
    d. 90^{th} %ile
    e. <u>95^{th} %ile</u>
17. Sophia is a 3'2" 4-year old girl who weighs 35 lbs. What is her body mass index?
    a. 13
    b. <u>17</u>
    c. 21
    d. 25
    e. 28
18. Using the attached growth chart, what is Sophia's BMI-for-Age-and-Gender percentile?
    a. 30^{th}
    b. 50^{th}
    c. 73th
    d. <u>87^{th}</u>
    e. 96^{th}
19. Sophia is classified as:
    a. Underweight
    b. Healthy weight
    c. <u>Overweight</u>
    d. Obese
    e. Very obese

20. As a health care provider, you should advise Sophia to:
    a. Lose 1 lb. per week
    b. Lose 1 lb. per month
    c. Maintain current weight
    d. Practice healthy eating and physical activity habits
    e. None of the above
21. Which of the following information is important to document for Sophia?
    a. Growth history
    b. Physical activity
    c. Sedentary time
    d. Family medical history
    e. All of the above

Obesity-related behaviors (children)

22. All of the following behaviors should be encouraged EXCEPT:
    a. Limit consumption of sugar-sweetened beverages
    b. Decrease television and screen time
    c. Increase intake of fruits and vegetables
    d. Skip breakfast to decrease food intake
    e. Enjoy family meals together
23. Which of the following activities are recommended for a child Sophia's age?
    a. Jogging for 30 minutes on a treadmill
    b. Playing tag with friends and family for 60 minutes
    c. Pilates class for 60 minutes
    d. Step aerobics video for 60 minutes
    e. Kickboxing class for 30 minutes
24. What is the maximum amount of 100% fruit juice that is recommended each day for children under the age of 6?
    a. 1-3 oz.
    b. 4-6 oz.
    c. 7-12 oz.
    d. 13-20 oz.
    e. Unlimited juice
25. What is the maximum amount of daily screen time in which children should engage?
    a. 2 hours
    b. 4 hours
    c. 6 hours
    d. 8 hours
    e. Unlimited screen time

Obesity and Older Adults

26. What is the prevalence of obesity among older adults?
    a. 10%
    b. 25%
    c. <u>40%</u>
    d. 60%
27. Older adults with chronic disease may experience a decreased ability to perform which of the following instrumental activities of daily living?
    a. Shopping for food
    b. Preparing meals
    c. Taking medications as prescribed
    d. <u>All of the above</u>
    e. A and C only
28. Older adults with chronic disease may require a caregiver to assist with activities of daily living (ADL). Which of the following is an example of an ADL?
    a. Getting dressed
    b. Taking care of personal hygiene
    c. Exercising
    d. All of the above
    e. <u>A and b only</u>
29. Older adults with chronic disease may experience a diminished quality of life due to a decreased ability to engage with their community, family, and friends and a loss of independence.
    a. <u>True</u>
    b. False
30. To prevent and/or delay the death and decline associated with chronic disease, who needs to engage in health promoting behaviors?
    a. Children and adolescents
    b. Young adults
    c. Middle adults
    d. Older adults
    e. <u>All of the above</u>

Demographic Data: The following questions help us understand the diversity of students in our FDNS 4050 classes.

31. Gender
    a. Male
    b. Female
32. Race/ethnicity
    a. Asian
    b. Hispanic
    c. Non-Hispanic black
    d. Non-Hispanic white
    e. Other
    f. Prefer not to answer
33. Age (open response)
34. Year in college (i.e., first year, second year, graduate student)
    a. First year undergraduate
    b. Second year undergraduate
    c. Third year undergraduate
    d. Fourth year undergraduate
    e. Fifth year or beyond undergraduate
    f. Graduate student
    g. Other
35. Intended or Declared College Major (open response)

APPENDIX H

FDNS 4540 PRE-TEST/POST-TEST

Environmental Factors Associated with Obesity

1. Which of the following elements of the built environment would increase opportunities for physical activity?
    a. Sidewalks
    b. Cross-walks with signals
    c. Bike lanes
    d. <u>All of the above</u>
    e. A and C Only
2. Many low-income neighborhoods experience which of the following barriers to healthy behaviors?
    a. Decreased number of supermarkets and grocery stores
    b. Unsafe neighborhood parks
    c. Increased access to transportation
    d. Decreased number of convenience stores
    e. <u>A and B Only</u>
3. Residents in rural areas may experience which of the following barriers to healthy behaviors?
    a. Increased distance to supermarkets and grocery stores
    b. Increased distance to schools
    c. Lack of sidewalks
    d. Lack of variety of fresh fruits and vegetables in small grocery stores
    e. <u>All of the above</u>
4. Which of the following elements of the built environment may promote **unhealthy** eating?
    a. <u>Fast-food restaurant within one mile of a school</u>
    b. Bike lanes leading from surrounding neighborhoods to school
    c. A farmers market at the local church every Friday and Saturday
    d. All of the above
    e. None of the above
5. Land-use planning can be used in which of the following ways to promote healthy behaviors?
    a. Encourage supermarkets to move into low-income areas
    b. Provide space for community gardens
    c. Ensure that streets are pedestrian and bike friendly
    d. <u>All of the above</u>
    e. B and C Only

6. Jasmine lives in a neighborhood two streets over from the local elementary school. She carpools with two other children who live on the same street because the school bus does not pick up students who live within one mile of the school.
    a. List three environmental factors that may affect Jasmine's need to ride to school (open response).
        i. Lack of sidewalks or bike lanes
        ii. Lack of cross-walk at busy intersection
        iii. Unsafe neighborhood
    b. What is one possible low-cost way to encourage Jasmine and other neighborhood children to walk or bike to school? (open response)
        i. Start a "walking school bus" led by parent volunteers
        ii. Parents can work with schools to volunteer to be crossing guards
7. Cynthia lives in an urban neighborhood near a college campus. She does most of her food shopping at the local independent grocery store. She rarely purchases fresh fruits and vegetables because they are "too expensive." What are two community programs that may benefit Cynthia? (open response)
    a. Community garden
    b. Agricultural co-op
    c. Farmer's market
8. Natasha is a nurse practitioner who works in a rural area. She has noticed that many children in her county are overweight or obese, and she attributes this trend partly to lack of physical activity, as she never sees children playing outdoors.
    a. List two potential barriers to physical activity for these children (open response).
        i. Distance between houses is difficult for children to play with each other
        ii. Lack of access to neighborhood parks
        iii. Lack of access to recreational facilities
        iv. Land may not be safe or available for play
        v. Lack of side-walks or bike lanes
    b. What could be done to encourage more physical activity for these children? (open response)
        i. Work with schools to use playground equipment after-hours
        ii. Arrange carpools to recreational facilities
        iii. Work with churches to host physical activity opportunities
        iv. Work with schools to host physical activity opportunities on the weekend, potentially arrange for use of buses

School Factors Associated with Healthy and Unhealthy Behaviors

9. Which of the following is associated with increased intake of calorie-dense foods at school?
    a. Vending machines
    b. School canteens
    c. Farm-to-school initiatives
    d. All of the above
    e. A and B only
10. The school wellness policy should:
    a. Include nutrition guidelines to promote student health and reduce childhood obesity for foods in the school lunch program only
    b. Encourage input from the general public
    c. Include only nutrition and physical activity guidelines
    d. All of the above
    e. Only A and B
11. The school lunch program should meet which of the following guidelines?
    a. Be consistent with the Dietary Guidelines for Americans
    b. Decrease the amount of sodium in meals
    c. Offer only low-fat flavored milk
    d. All of the above
    e. A and B only
12. Which of the following are NOT considered foods that compete with the school lunch program?
    a. Vending machine items
    b. Cupcakes for a child's birthday
    c. Oranges and grapefruit sold as a band fundraiser delivered during school hours
    d. Graham cracker cookies in the after-school program
    e. All of the above are competitive foods
    f. None of the above are competitive foods
13. Which of the following people should **NOT** be involved in development of the school wellness policy?
    a. Superintendent
    b. Teacher
    c. Student
    d. Pediatrician
    e. Parent
    f. All of the above should be involved
14. Which of the following may discourage overweight and obese students from participating in physical education classes?
    a. Weight-based teasing
    b. Focusing on aerobic activities only
    c. Students "picking" teams
    d. All of the above
    e. A and C only

15. Which of the following students are least likely to attend daily physical activity classes?
    a. Elementary school students
    b. Middle school students
    c. <u>High school students</u>
16. Mrs. Smith teaches 3rd grade at Hawkins Elementary School. She likes to reward her students for good work and good behavior. Which of the following rewards would likely be consistent with a school wellness policy?
    a. Five minutes of nap-time
    b. Candy bar
    c. Trail mix
    d. <u>Practicing a sanctioned "flash mob" dance for the end of school</u>
    e. None of the above

<u>Identifying Community Policies Associated with Obesity Prevention and Treatment</u>

17. A coalition of community members in a mid-size urban town wants to improve health and decrease obesity in their community. According to the CDC, which of the following policies should they consider?
    a. Provide incentives for large supermarkets to locate in low-income areas
    b. Promote breastfeeding support in hospitals and worksites
    c. Develop infrastructure for expanded road systems
    d. All of the above
    e. <u>A and B only</u>
18. Which of the following is a potential target for a policy to address obesity?
    a. Limit the size of sugar-sweetened beverages sold in the county
    b. Limit the portion size of energy-dense snacks sold in schools
    c. Restrictions on advertisements of energy-dense foods
    d. <u>All of the above</u>
    e. A and B only
19. List the results of one policy in the Athens, Georgia area that you feel increases access to healthy food or physical activity? [Free Response]
    a. Sidewalks around most areas of the university
    b. Bike lanes throughout most of the city
    c. Bus service to larger supermarkets available
    d. Farmers' market available

Demographic Data: The following questions help us understand the diversity of students in our FDNS 4540 classes.

20. Gender
    a. Male
    b. Female
21. Race/ethnicity
    a. Asian
    b. Hispanic
    c. Non-Hispanic black
    d. Non-Hispanic white
    e. Other
    f. Prefer not to answer
22. Age (open response)
23. Year in college (i.e., first year, second year, graduate student)
    a. First year undergraduate
    b. Second year undergraduate
    c. Third year undergraduate
    d. Fourth year undergraduate
    e. Fifth year or beyond undergraduate
    f. Graduate student
    g. Other
24. Intended or Declared College Major (open response)

APPENDIX I

FDNS 4500 PRE-TEST/POST-TEST

FDNS 4500 Pre-Test/Post-Test

Instructions: Answer the following questions to the best of your knowledge.

Nutrition Assessment

1. Samantha is a 25-year old who has come to you for weight management counseling. Samantha is 5'6" and 220 lbs. She is a first-grade teacher working on a graduate degree in educational leadership. Samantha lives with two roommates who are also in her program. List five topics that should be included when assess the diet history of a client who has come to see you for weight management.
    a. Home life and meal patterns (i.e., who shops for groceries, who cooks meals, where are meals eaten, does the client eat alone or with family and friends)
    b. Ethnic and cultural background that influences food intake
    c. Attitude toward food and eating
    d. Physical activity
    e. Allergies, intolerances, or food avoidance
    f. Recent weight change or weight history
    g. Dietary or nutritional problems
    h. Dental or oral health
    i. Appetite
2. You decide to use a 24-hour recall to assess Samantha's diet history. She reports the following meals:

    Breakfast: Scrambled eggs, toast, and orange juice at school. "I don't usually eat at school, but I was running late yesterday."
    Lunch: Salad with "a little bit of ranch dressing" and a few croutons on top. "I didn't have any dessert at lunch yesterday."
    Snack: Crackers out of the vending machine, but can't remember which ones she bought yesterday
    Dinner: Lean Cuisine® Chili Lime Chicken frozen entrée, strawberry shortcake for dessert. "I usually make something for the week on the weekend, but I was out of town, so I've been having frozen dinners this week."
    Snack: Chex mix

    All of the following are disadvantages of using the 24-hour recall for this weight management client EXCEPT:
    a. The dietitian must probe for condiments used, additional foods consumed, cooking methods, and portion sizes
    b. The client may exaggerate low intake of foods or underreport high intakes of foods
    c. The previous day may not be "typical" for the client
    d. It does not rely on the client's memory
    e. All of the above are disadvantages of the 24-hour recall

3. All of the following are problems that may occur when a weight management client keeps a food diary or food record for 3-7 days EXCEPT:
    a. Client may forget to write down items, especially condiments
    b. Client may alter normal food intake because of reporting food intake
    c. The days recorded may not be typical for the client
    d. The client will likely measure every item consumed
    e. The client may not complete the food diary or food record
4. Which of the following suggestions may be MOST important to help a weight management client keep an accurate food diary or food record, especially related to omission of certain items or changing what is consumed during the period recorded?
    a. Ask the client to record two typical weekdays and one typical weekend day for a 3-day food record
    b. Provide guidelines for completing the food record, such as noting cooking method, how to measure or estimate portion sizes, and including anything added to the food (i.e., condiments)
    c. Provide a list of common condiments
    d. Emphasize that the diet history is for informational purposes to help the dietitian help the client, not to judge the client's diet
5. In addition to diet history, it is important to assess the anthropometrics of a weight management client to determine both baseline data (i.e., starting point) and additional risk for metabolic problems. What is the waist circumference associated with increased risk for metabolic problems for both men and women?
    a. Female = ≥ 35 inches
    b. Male = ≥ 40 inches
6. An assessment of a weight management client should also include medical information to document potential causes for obesity (i.e., endocrine disorders, neurological disorders, medications, and genetics), as well as complications associated with obesity. Which of the following is NOT a potential complication or increased risk for disease associated with obesity?
    a. Diabetes
    b. Metabolic syndrome
    c. Functional limitations
    d. Food allergies
    e. Some cancers

7. A nutritional assessment should include not only current dietary information but previous weight and dieting history. Jacob is a 20-year old sophomore who has come to you for weight management. He has always been heavy ("I've always been at the 96th percentile for height and weight – I was just a big kid"), but recently gained about 10 lbs. since starting college last year. Although he accepts "being big," he doesn't want his weight to get out of control. Jacob tried a high-protein diet during his senior year of high school, but only lost about 5 lbs. He hasn't actively tried to lose weight since that time. Which of the following weight and dieting history topics may be MOST important in your assessment?
    a. Highest/lowest adult weight
    b. Patterns of weight gain and weight loss
    c. Number and types of diets previously tried
    d. Success of previous weight loss efforts
8. Many factors (social history) may directly or indirectly impact a client's attempts to lose weight. Ava is a 32-year old mother of three young children under the age of 8. She works as a part-time administrative assistant at a small law firm in a rural town. Ava works not so much for extra income as she does for connection to the community. Her husband works shift-work (nights) at a local plant. Fortunately, Ava's mother is able to care for the children during the day when she does work. About six months ago, Ava's husband told her that the local plant may downsize, and it's likely that his job will be relocated to another state. Which of the following factors may have MOST impacted Ava's recent weight gain of 10 lbs.?
    a. Economics or financial constraints
    b. Social support system
    c. Time constraints
    d. Life stressors
    e. All of the above
9. Exercise is the other side of the energy balance equation. Jamie is a 59-year old female who has gained about 110 lbs. over the last forty years and now has a BMI of 45. She has not formally exercised since high school, although she used to walk around her neighborhood on occasion until she had knee-replacement surgery six years ago. Given this information, which of the following topics would be MOST important to explore with Jamie at this time?
    a. How receptive is Jamie to a structured exercise program
    b. In which physical activities did Jamie engage during high school
    c. Does Jamie have any physical problems with exercises such as walking
    d. All of the above
    e. A and C only

10. It is important to assess a client's readiness to make dietary changes. Jack is a 37-year old senior vice president at a large company in the southwestern United States. He has been referred to you for weight management because he has a BMI of 38, hypertension, and pre-diabetes. He states that he is here to lose weight because "his doctor told him that he needs to lose at least 75-100 lbs. or risk serious health problems." He is concerned about his health and knows that eating well and exercising would improve his health. He states that he had been successful losing weight previously in his late twenties ("I lost about 80 lbs. at the time, but I gained it back – plus some"). However, he travels frequently and doesn't have as much time to plan meals, prepare meals, and exercise – which is what he did the first time he lost weight. What reflection below MOST represents Jack's readiness to make dietary and physical activity changes?
    a. Jack is not interested in losing weight at this time because he does not believe that weight loss will benefit him.
    b. Jack believes that behavioral changes will improve his health but he faces too many barriers to change at this time.
    c. Jack's wants to lose a lot of weight with little effort and does not understand the continuing work to maintain a healthy weight.
    d. Jack does not believe that he can be successful losing such a large amount of weight.

For questions 11-22, refer to the following information:

Jen is a 24-year old female who is seeking your guidance for weight management because she is getting married in six months and would like to "look nice" in her wedding dress. Jen is currently a graduate student in international business who will graduate next Spring semester. She is in the process of interviewing for positions with companies that have operations in South American countries. Her goal is to serve as a liaison between a company and local businesses in those areas. Below is a summary of Jen's information that you have collected.

Information
Age: 24
Height: 5'3"
Weight: 175 lbs.
Waist circumference: 38"

Previous Medical History: No significant medical history

Family Medical History: Positive for DM2 (both grandmothers, two aunts), cardiovascular disease (paternal grandfather)

Blood Pressure: 138/82 mmHg

<u>Fasting Lipid Panel</u>
Total Cholesterol: 215 mg/dL

Triglycerides: 190 mg/dL
LDL-C: 145 mg/dL
HDL: 35 mg/dL

Basic Metabolic Panel
Glucose: 118 mg/dL
Sodium: 138 mEq/L
Potassium: 3.7 mEq/L
Chloride: 100 mmol/L
Carbon Dioxide: 22 mmol/L
Blood Urea Nitrogen: 10 mg/dL
Creatinine: 0.7 mg/dL
Calcium: 8.3 mg/dL

Weight and Dieting History

Highest adult weight: 210 lbs. (gained more than the "freshman 15" first year of college)
Lowest adult weight: 160 lbs. (lost weight during junior year following a popular weight loss plan)
Dieting history: Has tried several popular diets, including meal replacements, prepackaged meals, and online meal planning

24-Hour Food Recall
Breakfast: Skipped
Snack (11:00 a.m. on campus): Peanut butter crackers (1 pack); 1 20 oz. bottle cola
Lunch (2:30 p.m. on campus with a friend): Beef burrito with lettuce and tomatoes (1/2 cup total), black beans (1/4 cup), salsa (1/8 cup), cheddar cheese (2 tbsp.), sour cream (1 tbsp.); tortilla chips (about 25), guacamole (about ¼ cup); 1 16 oz. cup of Coca-Cola
Snack (5:30 p.m. at apartment): 1 small mango
Dinner (8:00 p.m. at restaurant with three friends): Garden salad with 2 tbsp Italian dressing, ¼ cup croutons; meat lasagna (about 2 inches by 4 inches); 2 garlic-butter bread sticks; 1 slice tiramisu (about 3 inches square); coffee with 2 creamers and 2 packets of sugar
Snack (12:00 a.m. at apartment): Chips (about 20); 1 20 oz. bottle cola

Exercise History

Jen played soccer the first two years in high school but did not continue due to focus on academics. She likes to dance but is not able to do it regularly due to school commitments. She does not currently exercise but would like to if she had more time. She walks to and from her car and between classes, which is a total of 15 minutes most days of the week.

11. What is Jen's BMI? What is her BMI classification? (underweight, normal weight, overweight, obese – if so, give class of obesity)
    a. BMI = 31.1
    b. Obese (Class 1)
12. List three anthropometric, medical, or laboratory values that show an increased risk for chronic disease.
    a. BMI greater than 30
    b. Waist circumference greater than 35 inches
    c. Blood pressure: 138/82 mmHg
    d. Total cholesterol greater than 200 mg/dL
    e. Triglycerides greater than 150 mg/dL
    f. HDL less than 50 mg/dL
    g. Glucose greater than 100 mg/dL
13. What is another risk factor for chronic disease in Jen's history?
    a. Family history of diabetes and cardiovascular disease
    b. Physical inactivity

14. Which factor seems to present the biggest challenge to Jen concerning weight management
    a. Time constraints or need for convenience (note use of prepackaged meals and meal replacements, eating out)
15. Using the Mifflin-St. Jeor equation, estimate Jen's energy needs to lose one pound per week. (Resting Metabolic Rate [kcal] = 10 x weight (kg) + 6.25 x height (cm) – 5 x age (y) – 161; Activity factors = 1.3 sedentary; 1.5 moderately active; 1.7 very active)
    a. RMR = 1515 kcal
    b. Activity factor 1.3 = 1970 kcal
    c. For weight loss (subtract 500 kcal) = 1470 kcal
16. Assuming that the 24-hour recall is representative of typical food and nutrient intake in terms of general food groups, carbohydrate, protein, and fat, identify two dietary/physical activity behaviors that Jen may need to change in order to lose weight and improve her risk factors for chronic disease.
    a. Decrease intake of fat (especially saturated fat as evidenced by use of high-fat dairy products and snack items)
    b. Decrease intake of sugar-sweetened beverages as evidenced by frequent consumption of sugar-sweetened cola and adding sugar to coffee
    c. Increase intake of fruits and vegetables (currently consuming less than 1 cup fruit and approximately 1-2 cups vegetables per day)
    d. Increase physical activity to 150 minutes moderate physical activity each week

17. From Jen's history, what topic may you want to explore more to help facilitate her weight loss? [**Open Response – no score**]
    a. Jen has had some success with dieting – it would be important to understand what worked well and what was difficult with dieting.
    b. Jen may need a support network, especially since she eats frequently with friends. It may be helpful to explore how supportive her friends are regarding weight loss.
    c. Jen's financial situation may be helpful to explore – she does eat out with friends, but the food she has on her own is more snack-oriented.
    d. It would be helpful to explore Jen's health beliefs related to weight status.
18. Do you perceive that Jen is ready to make changes? Why or why not? [**Open Response – no score**]
    a. Jen seems externally motivated by her wedding.
    b. Jen claims to want to dance but does not have time (without mentioning if she can make time)
    c. Jen seems to make choices based on school and work (i.e., quitting soccer in high school) – not sure how important health is to her
19. What are two concerns that you may have about the 24-hour recall information?
    a. Jen may have forgotten some items, especially condiments
    b. Jen may have underestimated or overestimated some portion sizes
    c. This may not be a typical day for Jen
20. What is Jen's primary reason for wanting to lose weight?
    a. Jen wants to look nice in her wedding dress.
21. What is an appropriate initial weight loss goal for Jen?
    a. 70 lbs. for low-end normal weight BMI
    b. 65 lbs. to obtain ideal body weight
    c. 37 lbs. for normal weight BMI
    d. 17 lbs. for 10% initial body weight
22. The intervention for this client will be nutrition education delivered via classes and individual nutrition counseling. Following this intervention, what outcomes would you want to monitor following the intervention? [Correct response dependent on answer to #16]
    a. Weight
    b. Reported number of sugar-sweetened beverages consumed each day
    c. Reported amount of physical activity each week
    d. Calorie intake
    e. Intake of saturated fat
    f. Average intake of fruits and vegetables

Demographic Data: The following questions help us understand the diversity of students in our FDNS 4500 classes.

1. Gender
    a. Male
    b. Female
2. Race/ethnicity
    a. Asian
    b. Hispanic
    c. Non-Hispanic black
    d. Non-Hispanic white
    e. Other
    f. Prefer not to answer
3. Age (open response)
4. Year in college (i.e., first year, second year, graduate student)
    a. First year undergraduate
    b. Second year undergraduate
    c. Third year undergraduate
    d. Fourth year undergraduate
    e. Fifth year or beyond undergraduate
    f. Graduate student
    g. Other
5. Intended or Declared College Major (open response)

APPENDIX J

FDNS 4520 PRE-TEST/POST-TEST

FDNS 4520 Pre-Test/Post-Test

Instructions: Answer the following questions to the best of your knowledge.

1. List two environmental factors that may influence eating decisions.
    a. **Proximity to fast-food restaurants**
    b. **Proximity to grocery store versus convenience store**
    c. **Availability of public transportation**
2. List two environmental factors that may influence physical activity decisions.
    a. **Proximity to park or recreation facility for physical activity**
    b. **Availability of sidewalks or bike lanes**
    c. **Availability of public transportation (access to grocery stores)**
3. List two psychosocial factors that may influence eating decisions.
    a. **Cultural norms for eating certain foods**
    b. **Perception of food or reasons for food consumption (i.e., as fellowship, for celebration, for family bonding)**
4. There can be many behavioral, emotional, or environmental triggers to eat outside of hunger. Which of the following is an emotional trigger to eat?
    a. Before or after a difficult final exam
    b. Feeling bored or tired and believing that food will help
    c. Seeing a favorite snack in the kitchen cabinet
    d. All of the above
    e. **A and B only**
5. Which of the following is a behavioral trigger to eat?
    a. **Stopping by Starbucks on the way home from school/work every day**
    b. Passing a vending machine on the way to class
    c. Seeing a box of cupcakes at a club meeting
    d. All of the above
    e. B and C only
6. Lindsey is a client who has been seeing you for weight management counseling. At your last session, you asked Lindsey to keep a three-day record of her eating habits. She noted what she was feeling and why she decided to eat in this record to identify cues or triggers to eat. She realized after keeping this record that she often eats although she is not hungry when other people are eating around her (i.e., colleagues at work, roommates at home). Whenever she has tried to resist, these "others" encourage her to just "have one bite." What is a practical way that Lindsey can avoid this trigger to eat something unhealthy?
    a. Avoid being at work or home when others will be eating
    b. Skip breakfast so that she has enough kcal leftover in her daily eating plan to cover these extra snacks
    c. **Offer to bring something healthy for everyone to eat**
    d. All of the above
    e. B and C only

7. Behavioral change theories seek to explain how to modify behavior through changing mediating or moderating factors. An ad campaign, such as Strong4Life's television ads linking childhood obesity to earlier mortality in adulthood, focused on raising awareness of the severe health risks associated with obesity. Which behavior change theory informed this campaign?
    a. Social cognitive theory
    b. Health Belief Theory
    c. Theory of Reasoned Action
    d. Transtheoretical Model/Stages of Change
8. Kalia has come to you for weight management counseling. She was referred by her physician because her BMI is 33 and she has dyslipidemia, as well as pre-diabetes. When asked why she has come to visit you, Kalia responds, "My physician said that I need to lose weight because I'm at risk for diabetes and cardiovascular disease, but my whole family is on the heavy side, so I don't see a problem." What is Kalia's stage of change in the Transtheoretical model?
    a. Precontemplation
    b. Contemplation
    c. Preparation
    d. Action
    e. Maintenance
9. Social cognitive theory focuses on the interaction between personal concepts (i.e., skills, self-efficacy, and outcome expectancies) and environmental factors (i.e., modeling, availability of healthy food and physical activity outlets).
    a. True
    b. False
10. Raye is planning a dietary intervention in her dorm by raising funds for a "healthy vending machine" that offers fresh fruit and light yogurt and placing signs promoting taking stairs instead of the elevator. Which theory of behavior change informs this environmental cue approach?
    a. Health Belief Theory
    b. Theory of Reasoned Action
    c. Transtheoretical Model/Stages of Change
    d. Social Ecological Model
    e. Knowledge-Skills-Attitudes
11. What is the reason for using self-monitoring in weight management?
    a. Clients become aware of the dietary and physical activity behaviors, what triggers these behaviors, where and when these behaviors occur, and the results (long-term and short-term) of these behaviors so that goals for behavior change can be set.

12. Nadia tries to eat healthy to set a good example for her daughters. Is Nadia's motivation autonomous or controlled?
    a. **Controlled**

According to Social Determination Theory, clients need support for autonomy, competence, and relatedness. Dawn has come to you for dietary advice to lose weight. You immediately provide several pamphlets related to healthy eating and physical activity and suggest that based on your initial assessment, Dawn should increase her fruit and vegetable intake, walk at least 30 minutes each day, and decrease the number of sodas that she consumes each day.

13. Which need are you not supporting?
    a. Autonomy
    b. Competence
    c. Relatedness
14. All of the following are ways to better support this need EXCEPT:
    a. Elicit and acknowledge client's perspectives and emotions before making recommendations.
    b. Supporting the client's choices and initiatives
    c. Providing a rationale for advice given
    d. Providing a checklist of behaviors to change
    e. Exploring how relevant health behaviors relate to client's aspirations in life
15. Ava has been seeing you for several months for weight management. She initially lost 5% of her body weight but has slowly regained the weight. Her BMI is 36 and she has type 2 diabetes and hypercholesterolemia. Is she a candidate for weight loss surgery? Explain.
    a. Yes – she has metabolic complications with a BMI greater than 35 and has had difficulty losing weight.
16. Sarah wants to lose 10% of her initial body weight. After talking with you, she decides that she wants to exercise five times a week. Which of the following is the best goal for the behavior?
    a. I will exercise Monday through Friday.
    b. I will exercise for 30 minutes five times a week.
    c. I will walk for 30 minutes five times a week.
    d. I will exercise for 30 minutes Monday through Friday.
    e. I will walk for 30 minutes Monday through Friday after dinner.

Kelly is the CEO of a small company that provides educational seminars for health professionals. She typically travels three or four days per week marketing the company's services to hospitals and physician practice groups. She has gained about 20 lbs. in the last year but would like to lose this weight. In talking with you, she realizes that she eats out frequently due to her work schedule. She sees this as a problem and vows to "cook more dinners at home."

17. Why is Kelly likely or not likely to achieve this goal?
    a. Kelly is likely to achieve this goal because she is dedicated to losing weight.
    b. Kelly is likely to achieve this goal because she recognizes her behavioral problem and sees a solution to change it.
    c. Kelly is unlikely to achieve this goal because it may not be realistic given her travel schedule.
    d. Kelly is unlikely to achieve this goal because she does not seem motivated to change.
18. What could be a better goal for Kelly?
    a. Find a job that requires less travel time
    b. Develop strategies to make healthier choices when eating out
    c. Take healthy snacks during travel
    d. All of the above
    e. B and C only
19. Jonathan is 36 years old and has been referred to you for weight management, as his BMI is 34 and he has hypertension and dyslipidemia. During the initial assessment, you determine that Jonathan needs more information about what is a healthy diet. What is a good free resource that you can share with Jonathan (you may assume that he has internet access).
    a. Dietary Guidelines for Americans
    b. ChooseMyPlate.gov
20. After Jonathan's initial assessment, you calculate that his usual energy intake is 2900 kcal with estimated needs of 2000 kcal (for weight loss). His usual macronutrient intake is 50% CHO, 35% fat (14% saturated fat), and 15% protein. He consumes about 2 cups of fruits and/or vegetables each day, almost no whole grain products, and <1 servings of a calcium-rich food each day. Which of the following is an appropriate nutrition intervention for Jonathan based on the information given (think about question #13, as well)?
        1. General healthy diet
        2. Nutrition education – priority modifications
        3. Fat modified diet (saturated fat < 7% total kcal)
        4. Nutrition counseling theoretical basis/approach – Health Belief model
        5. Nutrition counseling strategies – stress management

    a. 1 and 2
    b. 1, 2 and 3
    c. 4 and 5
    d. 1, 4, and 5
    e. 1, 2, 3, 4, and 5

21. What outcomes and criteria will be important to measure at Jonathan's follow-up in three months?

    1. Weight with a goal of losing 3 lbs. per week
    2. Increase in nutrition knowledge as evidenced by changes in dietary habits
    3. Decrease in total kcal intake (to recommended 2000 kcal per day)
    4. Decrease in intake of saturated fat (to <7%)
    5. Increase in intake of fruits and vegetables (to recommended number of servings per Dietary Guidelines for Americans)

    a. 3 and 4
    b. 1, 3, and 4
    c. 2 and 5
    d. 2, 3, 4, and 5
    e. 1, 2, 3, 4, and 5

APPENDIX K

STUDENT SATISFACTION SURVEY

Online Collaborative Case Study Module Student Satisfaction Survey

This survey asks questions about your experience with the online collaborative case study module. It includes questions about the various activities, group experience, and overall learning experience. Thank you for your opinions!

Please rate the following statements based on how much you agree with the statement.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. The individual self-reflection raised my awareness of the knowledge, values, and experiences I brought to the case study.					
2. The group discussions helped me think about additional information I did not initially consider.					
3. The "first step" and "next step" dropbox assignments helped me apply information I learned in a practical way.					
4. The "first step" and "next step" dropbox assignments helped me complete the final group assignment.					
5. The final group assignment helped me develop skills I would use in practice.					
6. The self-evaluation helped me assess what I learned.					
7. I feel confident in my skills to address obesity in a similar situation.					
8. I feel confident in my skills to find credible information about obesity prevention and treatment.					
9. The case study was easy to navigate on eLC.					
10. The length of time between parts of the case study was adequate.					
11. The variety of activities contributed to my learning.					
12. It was easy to work with my online group.					
13. The expectations for each part of the case study were clear.					
14. Group activities contributed to my learning.					
15. The case study should be an individual assignment.					

What helped your learning in the case study module?

How would you change the case study module?

APPENDIX L

CHAPTER 3 (FDNS 2100) SUPPLEMENTARY TABLES

Table L.1. Intro students' knowledge of obesity-related health risks (modified ORK-10) by race/ethnicity, year in college, intended or declared major, gender, and semester of enrollment

	n	Mean Score (%)	Std. Deviation	Median	*P*-Value
Race or Ethnicity					0.17
Asian American	43	66.2	14.6	66.7	
Hispanic	14	71.4	12.8	73.0	
Non-Hispanic Black	26	70.6	13.9	73.1	
Non-Hispanic White	320	71.0	12.4	72.2	
Other	23	70.2	13.9	71.9	
No Response	5	62.0	2.7	62.0	
Year in College					0.73
First year	55	72.5	12.4	74.5	
Second year	135	70.1	11.9	71.5	
Third year	161	70.3	14.0	70.8	
Fourth year	69	69.4	11.7	71.5	
Fifth year or beyond or graduate	11	71.8	14.9	75.0	
Intended or Declared Major					0.41
Foods and Nutrition	56	70.4	12.4	71.3	
Exercise Science	83	72.3	13.7	73.4	
Health Promotion and Behavior	47	71.0	13.4	71.7	
Human Development and Family Sciences	48	72.2	10.6	75.0	
Other Science/Health	85	70.1	13.6	70.6	
Other Majors	104	68.4	12.4	69.4	
No Response/Undecided	8	66.9	11.9	63.8	
Gender					0.35
Male	85	71.5	12.9	72.1	
Female	345	70.1	12.8	71.4	
Semester of enrollment					0.003
Spring 2013	194	72.4	11.9	73.3	
Fall 2013	237	68.8	13.3	68.9	

Table L.2. Comparison of knowledge of obesity-related health risks (modified ORK-10) by class of enrollment (Intro vs. Advanced)

	n	Mean Score (%)	Std. Deviation	Median	*P*-Value
Intro	431	70.4	12.8	71.6	<0.001
Advanced	45	84.6	11.7	86.8	

Table L.3. Comparison of knowledge of obesity-related health risks (original ORK-10) by class of enrollment (Intro vs. Advanced)

	n	Mean Score (%)	Std. Deviation	Median	*P*-Value
Intro	431	71.3	15.5	72.4	<0.001
Advanced	45	90.2	11.0	92.2	

Table L.4. Modified ORK-10 question analyses comparing Intro and Advanced participants

	Intro (n = 431)			Advanced (n = 45)			
	Correct	**Incorrect**	**Don't Know**	**Correct**	**Incorrect**	**Don't Know**	***P*-Value**
1. Adults are considered obese if their body mass index (BMI) is 30 or greater [True]	*346 (80)	24 (6)	61 (14)	45 (100)	0 (0)	0 (0)	**0.005**
2. A person with a "beer gut" has an increased risk of getting diabetes [True]*	324 (75)	61 (14)	46 (11)	37 (82)	7 (16)	1 (2)	0.20
3. Obesity increases the risk of getting colon cancer [True]*	338 (78)	22 (5)	71 (17)	38 (84)	7 (16)	0 (0)	**0.001**
4. An obese person who gets diabetes needs to lose at least 40% of their body weight for clear health benefits [False]*	175 (41)	85 (20)	171 (40)	40 (89)	3 (7)	2 (4)	**<0.001**
5. Obese people can expect to live as long as non-obese people [False]*	408 (95)	17 (4)	6 (1)	42 (93)	3 (7)	0 (0)	0.51
6. Obesity increases the risk of getting breast cancer after menopause [True]*	225 (52)	66 (15)	140 (33)	31 (69)	10 (22)	4 (9)	**0.004**
7. There is no major health benefit if an obese person who gets diabetes loses weight [False]*	388 (90)	15 (4)	28 (7)	44 (98)	1 (2)	0 (0)	0.18
8. Obesity does not increase the risk of developing high blood pressure [False]*	421 (98)	3 (1)	7 (2)	45 (100)	0 (0)	0 (0)	0.59
9. It is better for a person's health to have fat around the hips and thighs than around the stomach and waist [True]*	262 (61)	95 (22)	74 (17)	43 (96)	2 (4)	0 (0)	**<0.001**
10. Obesity increases the risk of getting a food allergy [False]*	186 (43)	77 (18)	168 (39)	41 (91)	3 (7)	1 (2)	**<0.001**
11. Obesity increases the risk of infertility in women but not men [False]	183 (43)	93 (22)	155 (36)	34 (76)	11 (24)	0 (0)	**<0.001**
12. A woman who is obese prior to pregnancy is more likely to have an obese child [True]	282 (65)	81 (19)	68 (16)	31 (69)	12 (27)	2 (4)	0.09
13. Excess weight gain during pregnancy is not associated with a child's risk of being obese [False]	122 (28)	230 (53)	79 (18)	28 (62)	14 (31)	3 (7)	**<0.001**
14. Overweight children are more likely to be even more obese adults [True]	383 (89)	31 (7)	17 (4)	42 (93)	2 (4)	1 (2)	0.65
15. Obese children are not more likely	373	12	46	31	13	1	**<0.001**

	Intro (n = 431)			Advanced (n = 45)			
	Correct	**Incorrect**	**Don't Know**	**Correct**	**Incorrect**	**Don't Know**	***P*-Value**
to develop type 2 diabetes [False]	(87)	(3)	(11)	(69)	(29)	(2)	
16. Obese children are more likely to have asthma [True]	340 (79)	31 (7)	60 (14)	40 (89)	3 (7)	2 (4)	0.19
17. Children with autism are more likely to be obese [False]	242 (56)	43 (10)	146 (34)	36 (80)	7 (16)	2 (4)	**<0.001**
18. Obesity increases a child's risk of getting gallstones [True]	242 (56)	28 (7)	161 (37)	27 (60)	14 (31)	4 (9)	**<0.001**
19. Excess body weight can affect the shape and strength of a child's bones [True]	406 (94)	6 (1)	19 (4)	42 (93)	3 (7)	0 (0)	**0.018**
20. Obese children are more likely to have poor self-esteem, which often continues into adulthood [True]	422 (98)	4 (1)	5 (1)	44 (98)	1 (2)	0 (0)	0.56

*Indicates original ORK-10 items

APPENDIX M

CHAPTER 4 (FDNS 4050) SUPPLEMENTARY TABLES

Table M.1. Change in knowledge about obesity management topics by gender in a life cycle nutrition class

	n	Pre-test Mean (%) (Std. Deviation)	Post-test Mean (%) (Std. Deviation)	Change in Score Mean (%) (Std. Deviation)
Male	15	68.2 (10.2)	76.7 (7.5)	8.4 (10.1)
Female	71	65.7 (11.3)	76.3 (9.4)	10.6 (11.3)

No significant differences noted

Table M.2. Change in knowledge about obesity management topics by race/ethnicity and year in college in a life cycle nutrition class

	n	Pre-test Score[a] (Std. Deviation)	Post-test Score[b] (Std. Deviation)	Change in Score[c] (Std. Deviation)
Race/Ethnicity				
Asian	14	60.5 (12.7)	76.0 (8.6)	15.5 (9.0)
Non-Hispanic black	6	67.8 (11.9)	73.3 (5.6)	5.6 (9.1)
Non-Hispanic white	58	67.9 (10.0)	77.3 (9.6)	9.4 (11.1)
Hispanic/Other/No response	8	62.1 (13.4)	72.5 (7.1)	10.4 (13.7)
Year in College				
Third-year (n = 28)	27	67.2 (12.2)[d]	75.9 (9.2)[e]	8.8 (10.0)[f]
Fourth-year (n = 45)	46	65.2 (11.1)	76.7 (8.9)	11.5 (12.0)
Fifth-year or beyond (n = 13)	13	67.2 (9.3)	75.9 (11.3)	8.7 (9.7)

[a] $P = 0.032$
[b] $P = 0.60$
[c] $P = 0.07$
[d] $P = 0.72$
[e] $P = 0.92$
[f] $P = 0.52$

APPENDIX N

CHAPTER 5 (FDNS 4540) SUPPLEMENTARY TABLES

Table N.1. Pre-test/post-test question frequency analyses in a community nutrition class

	Full Credit n (%)	Partial Credit n (%)	No Credit n (%)	*P*-Value*
1. Which of the following elements of the built environment would increase opportunities for physical activity? (D – All of the Above)				1.00
Pre-test	34 (87)	-	5 (13)	
Post-test	34 (87)**	-	5 (13)**	
2. Many low-income neighborhoods experience which of the following barriers to healthy behaviors? (E – A and B Only: Decreased number of supermarkets and grocery stores; unsafe neighborhood parks)#				0.66
Pre-test	36 (92)	-	3 (8)	
Post-test	37 (95)	-	2 (5)	
3. Residents in rural areas may experience which of the following barriers to healthy behaviors? (E – All of the Above)				**0.012**
Pre-test	33 (85)	-	6 (15)	
Post-test	39 (100)	-	0 (0)	
4. Which of the following elements of the built environment may promote unhealthy eating? (A – Fast-food restaurant within one mile of school)#				0.083
Pre-test	36 (92)	-	3 (8)	
Post-test	39 (100)	-	0 (0)	
5. Land-use planning can be used in which of the following ways to promote healthy behaviors? (D – All of the Above)#				0.42
Pre-test	37 (95)	-	2 (5)	
Post-test	35 (90)	-	4 (10)	
6. List three environmental factors that may affect Jasmine's need to ride to school (open response)				0.79
Pre-test	33 (85)	6 (15)	0 (0)	
Post-test	34 (87)	5 (13)	0 (0)	
7. What is one possible low-cost way to encourage Jasmine and other neighborhood children to walk or bike to school (open response)				0.083
Pre-test	21 (54)	-	18 (46)	
Post-test	15 (39)	-	24 (62)	
8. Cynthia lives in an urban neighborhood near a college campus and rarely purchases fresh fruits and vegetables because they are "too expensive." What are two community programs that may benefit Cynthia? (open response)				**0.011**
Pre-test	16 (41)	12 (31)	11 (28)	
Post-test	25 (64)	8 (21)	6 (15)	
9. Natasha is a nurse practitioner who works in a rural area. List two potential barriers to physical activity for children living in her area (open response)#				0.16

	Full Credit n (%)	Partial Credit n (%)	No Credit n (%)	*P*-Value*
Pre-test	36 (92)	3 (8)	0 (0)	
Post-test	38 (97)	1 (3)	0 (0)	
10. What could be done to encourage more physical activity for these children? (open response)				0.62
Pre-test	22 (56)	17 (44)	0 (0)	
Post-test	20 (51)	19 (49)	0 (0)	
11. Which of the following is associated with increased intake of calorie-dense foods at school? (E - A and B only: vending machines; school canteens)				0.47
Pre-test	17 (44)	-	22 (56)	
Post-test	20 (51)	-	19 (49)	
12. The school wellness policy should: (B – Encourage input from the general public)				0.18
Pre-test	2 (5)	-	37 (95)	
Post-test	5 (13)	-	34 (87)	
13. The school lunch program should meet which of the following guidelines? (E – A and B only: Be consistent with the Dietary Guidelines for Americans; Decrease the amount of sodium in meals)				**0.051**
Pre-test	22 (56)	-	17 (44)	
Post-test	15 (39)	-	24 (62)	
14. Which of the following are NOT considered foods that compete with the school lunch program? (D – Graham cracker cookies in the after-school program)				**0.023**
Pre-test	1 (3)	-	38 (97)	
Post-test	6 (15)	-	33 (85)	
15. Which of the following people should not be involved in development of the school wellness policy? (F – All of the above should be involved)[#]				1.00
Pre-test	36 (92)	-	3 (8)	
Post-test	36 (92)	-	3 (8)	
16. Which of the following may discourage overweight and obese students from participating in physical education classes? (D – All of the above)				0.53
Pre-test	26 (67)	-	13 (33)	
Post-test	28 (72)	-	11 (28)	
17. Which of the following students are least likely to attend daily physical activity classes? (C – High school students)				0.32
Pre-test	31 (80)	-	8 (21)	
Post-test	34 (87)	-	5 (13)	
18. Which of the following rewards would likely be consistent with a school wellness policy? (D – Practicing a sanctioned "flash mob" dance for the end of school)				**0.031**
Pre-test	18 (46)	-	21 (54)	
Post-test	26 (67)	-	13 (33)	

	Full Credit n (%)	Partial Credit n (%)	No Credit n (%)	*P*-Value*
19. How can Dawn, the chair of the committee to revise the local school wellness policy, ensure that the new policy will not be "put on the shelf"? (Open response)				0.41
Pre-test	6 (15)	33 (85)	0 (0)	
Post-test	7 (18)	31 (80)	1 (3)	
20. According to the CDC, which of the following policies should a community coalition consider to improve health and decrease obesity? (E – A and B only: Provide incentives for large supermarket to locate in low-income areas; Promote breastfeeding support in hospitals and worksites)				**0.051**
Pre-test	23 (59)	-	16 (41)	
Post-test	16 (41)	-	23 (59)	
21. Which of the following is a potential target for a policy to address obesity? (D – All of the above)				0.49
Pre-test	32 (82)	-	7 (18)	
Post-test	34 (87)	-	5 (13)	
22. List the results of one policy in the Athens, Georgia area that you feel increases access to healthy food or physical activity? (Open response)				1.00
Pre-test	34 (87)	-	5 (13)	
Post-test	34 (87)	-	5 (13)	

*P-value for paired t-test comparing post-test and pre-test score for question
**Percentages may not sum to 100 due to rounding
#Item deleted from final pre-test/post-test score due to >90% correct at pre-test and post-test

Table N.2. Change in knowledge about community-level factors and strategies to prevent obesity in a community nutrition class

	n	Mean	Std. Deviation	Std. Error Mean	*P*-Value
Pre-test	39	65.0	10.5	1.72	0.20
Post-test	39	67.1	10.8	1.43	

Table N.3. Change in knowledge about community-level factors and strategies to prevent obesity in a community nutrition class by gender

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Male	3	72.2 (10.2)	68.9 (5.1)	-3.3 (8.8)
Female	36	70.6 (9.1)	73.1 (9.2)	2.5 (8.9)

[a]p = 0.78 [b]p = 0.44 [c]p = 0.28

Table N.4. Change in knowledge about community-level factors and strategies to prevent obesity in a community nutrition class by race/ethnicity

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Asian	14	67.1 (9.3)	71.4 (6.6)	4.3 (7.7)
Non-Hispanic white	21	74.4 (7.8)	75.2 (8.9)	0.8 (7.4)
Non-Hispanic black, Hispanic, or Other	4	64.2 (5.7)	65.0 (12.9)	0.8 (18.5)

[a]p = 0.015 [b]p = 0.08 [c]p = 0.52

Table N.5. Change in knowledge about community-level factors and strategies to prevent obesity in a community nutrition class by pre-test score above or below mean

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Pre-test score below the mean	21	63.8 (6.1)	67.3 (6.8)	3.5 (10.1)
Pre-test score above the mean	18	78.9 (3.0)	79.3 (6.5)	0.4 (7.1)

[a]p <0.001 [b]p <0.001 [c]p = 0.28

Table N.6. Change in knowledge about community-level factors and strategies to prevent obesity in a community nutrition class by prior experience with an online collaborative case study module

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Previous experience	19	71.1 (8.7)	71.8 (8.5)	0.7 (6.4)
No previous experience	20	70.5(9.6)	73.8 (9.4)	3.3 (10.8)

[a]p = 0.85 [b]p = 0.48 [c]p = 0.36

APPENDIX O

CHAPTER 6 (FDNS 4500 AND FDNS 4520) SUPPLEMENTARY TABLES

Table O.1. Medical nutrition therapy I pre-test/post-test question analysis comparing paper-based and online groups (χ^2)

	Full Credit		Partial Credit		No Credit		
	Paper-Based n (%)*	Online n (%)*	Paper-Based n (%)*	Online n (%)*	Paper-Based n (%)*	Online n (%)*	*P*-Value
1. List five topics that should be included when assessing the diet history of a client who has come to see you for weight management. (open response)							
Pre-test	8 (40)	11 (44)	12 (60)	14 (56)	0 (0)	0 (0)	0.57
Post-test	5 (25)	9 (36)	14 (70)	16 (64)	1 (5)	0 (0)	0.88
Change in score							0.48
2. All of the following are disadvantages of using the 24-hour recall for this weight management client EXCEPT: (D – It does not rely on the client's memory)							
Pre-test	15 (75)	16 (64)	-	-	5 (25)	9 (36)	0.43
Post-test	13 (65)	16 (64)	-	-	7 (35)	9 (36)	0.94
Change in score							0.87
3. All of the following are problems that may occur when a weight management client keeps a food diary or food record for 3-7 days EXCEPT: (D – The client will likely measure every item consumed)							
Pre-test	18 (90)	24 (96)	-	-	2 (10)	1 (4)	0.42
Post-test	20 (100)	23 (92)	-	-	0 (0)	2 (8)	0.20
Change in score							0.33
4. Which of the following suggestions may be MOST important to help a weight management client keep an accurate food diary? (D – Emphasize that the diet history is for informational purposes to help the dietitian help the client, not to judge the client's diet)							
Pre-test	7 (35)	11 (44)	-	-	13 (65)	14 (56)	0.54
Post-test	10 (50)	15 (60)	-	-	10 (50)	10 (40)	0.50
Change in score							0.97
5. What is the waist circumference associated with increased risk for metabolic problems for both men and women? (open response – Female ≥ 35 inches (89 cm), Male ≥ 40 inches (102 cm)							
Pre-test	5 (25)	11 (44)	3 (15)	3 (12)	12 (60)	11 (44)	0.42
Post-test	3 (15)	8 (32)	12 (60)	13 (52)	5 (25)	4 (16)	0.39
Change in score							0.31

	Full Credit		Partial Credit		No Credit		
	Paper-Based n (%)*	Online n (%)*	Paper-Based n (%)*	Online n (%)*	Paper-Based n (%)*	Online n (%)*	*P*-Value
6. Which is NOT a potential complication or increased risk for disease associated with obesity? (D – Food Allergies)							
Pre-test	20 (100)	24 (96)	-	-	0 (0)	1 (4)	0.37
Post-test	19 (95)	23 (92)	-	-	1 (5)	2 (8)	0.69
Change in score							0.87
7. Jacob is a 20-year old sophomore who has always been heavy but recently gained about 10 lbs. since starting college last year. He had tried a high-protein diet his senior year in high school but only lost 5 lbs. He hasn't actively tried to lose weight since that time. Which of the following weight and dieting history topics may be MOST important in your assessment? (B – Patterns of weight gain and weight loss OR D – Success of previous weight loss efforts)							
Pre-test	14 (70)	22 (88)	-	-	6 (30)	3 (12)	0.13
Post-test	17 (85)	24 (96)	-	-	3 (15)	1 (4)	0.20
Change in score							0.24
8. Which of the following factors may have MOST impacted Ava's recent weight gain of 10 lbs.? (D – Life stressors)							
Pre-test	8 (40)	14 (56)	-	-	12 (60)	11 (44)	0.29
Post-test	**6 (30)**	**14 (56)**	**-**	**-**	**14 (70)**	**11 (44)**	**0.08**
Change in score							0.64
9. Jamie is a 59-year-old female who has gained about 110 lbs. over the last forty years and has a BMI of 45. She has not formally exercised since high school, although she used to walk around her neighborhood until she had knee replacement surgery six years ago. Given this information, which of the following topics would be MOST important to explore with Jamie at this time? (C – Does Jamie have any physical problems with exercises such as walking)							
Pre-test	3 (15)	1 (4)	-	-	17 (85)	24 (96)	0.20
Post-test	1 (5)	1 (4)	-	-	19 (95)	24 (96)	0.87
Change in score							**0.06**

	Full Credit		Partial Credit		No Credit		
	Paper-Based n (%)*	Online n (%)*	Paper-Based n (%)*	Online n (%)*	Paper-Based n (%)*	Online n (%)*	*P*-Value
10. Jack is concerned about his health and knows that eating well and exercising would improve his health. However, he travels frequently and doesn't have as much time to plan meals, prepare meals, and exercise – which is what he did the first time he lost weight. What reflection below MOST represents Jack's readiness to make dietary and physical activity changes? (B – Jack believes that behavioral changes will improve his health but he faces too many barriers to change at this time?)							
Pre-test	14 (70)	18 (72)	-	-	6 (30)	7 (28)	0.89
Post-test	17 (85)	23 (92)	-	-	3 (15)	2 (8)	0.46
Change in score							0.94
11. What is Jen's BMI? What is her BMI classification (give class if obese). (open response – BMI = 31.1, Obese Class I)							
Pre-test	16 (80)	13 (52)	3 (15)	7 (28)	1 (5)	5 (20)	0.13
Post-test	**19 (95)**	**18 (72)**	**1 (5)**	**7 (28)**	**0 (0)**	**0 (0)**	**0.045**
Change in score							0.47
12. List three anthropometric, medical, or laboratory values that show an increased risk for chronic disease. (open response)							
Pre-test	2 (10)	5 (20)	18 (90)	18 (72)	0 (0)	2 (8)	0.27
Post-test	**3 (15)**	**8 (32)**	**17 (85)**	**17 (68)**	**0 (0)**	**0 (0)**	**0.003**
Change in score							0.55
13. What is another risk factor for chronic disease in Jen's history? (open response – family history of diabetes and cardiovascular disease OR physical inactivity)							
Pre-test	**6 (30)**	**15 (60)**	**-**	**-**	**14 (70)**	**10 (40)**	**0.045**
Post-test	13 (65)	20 (80)	-	-	7 (35)	5 (20)	0.26
Change in score							0.67
14. Which factor seems to present the biggest challenge to Jen concerning weight management? (open response – time constraints OR need for convenience)							
Pre-test	**18 (90)**	**16 (64)**	**-**	**-**	**2 (10)**	**9 (36)**	**0.044**
Post-test	**13 (65)**	**22 (88)**	**-**	**-**	**7 (35)**	**3 (12)**	**0.07**
Change in score							**0.009**

	Full Credit		Partial Credit		No Credit		
	Paper-Based n (%)*	Online n (%)*	Paper-Based n (%)*	Online n (%)*	Paper-Based n (%)*	Online n (%)*	*P*-Value
15. Using the Miffin-St. Jeor equation, estimate Jen's energy needs to lose one pound per week. (open response – 1470 kcal)							
Pre-test	1 (5)	2 (8)	12 (60)	15 (60)	7 (35)	8 (32)	0.98
Post-test	2 (10)	3 (12)	13 (65)	17 (68)	5 (25)	5 (20)	0.35
Change in score							0.52
16. Assuming that the 24-hour recall is representative of typical food and nutrient intake, identify two dietary/physical activity behaviors that Jen may need to change in order to lose weight and improve her risk factors for chronic disease. (open response)							
Pre-test	19 (95)	24 (96)	1 (5)	0 (0)	0 (0)	1 (4)	0.36
Post-test	19 (95)	25 (100)	1 (5)	0 (0)	0 (0)	0 (0)	0.26
Change in score							0.34
17. What are two concerns that you may have about the 24-hour recall information? (open response – Jen may have forgotten some items, Jen may have underestimated or overestimated portion sizes, this may not be a typical day for Jen)[#]							
Pre-test	9 (45)	10 (40)	3 (15)	3 (12)	8 (40)	12 (48)	0.86
Post-test	10 (50)	12 (48)	0 (0)	2 (8)	10 (50)	11 (44)	0.43
Change in score							-
18. What is Jen's primary reason for wanting to lose weight? (open response – to look nice in her wedding dress)							
Pre-test	**20 (100)**	**20 (80)**	**-**	**-**	**0 (0)**	**5 (20)**	**0.034**
Post-test	17 (85)	23 (92)	-	-	3 (15)	2 (8)	0.46
Change in score							0.09
19. What is an appropriate initial weight loss goal for Jen? (D – 17 lbs. for 10% initial body weight)							
Pre-test	15 (75)	14 (56)	-	-	5 (25)	11 (44)	0.19
Post-test	10 (50)	14 (56)	-	-	10 (50)	11 (44)	0.69
Change in score							0.16
20. Following a nutrition education and individual counseling intervention, what outcomes would you want to monitor? (open response)							
Pre-test	14 (70)	17 (68)	6 (30)	6 (24)	0 (0)	2 (8)	0.42
Post-test	16 (80)	21 (84)	4 (20)	3 (12)	0 (0)	1 (4)	0.53
Change in score							0.67

*All scores shown as percentage - may not sum to 100% due to rounding [#]Item not included in final pre-test/post-test score due to ambiguity of question intent

Table O.2. Change in knowledge of nutrition assessment of obesity in a medical nutrition therapy I class (N = 44)

	Mean	Std. Deviation	Std. Error Mean	P-Value
Pre-test	66.9	10.8	1.62	
Post-test	70.1	10.2	1.54	
Post-test – Pre-test	3.2	12.0	1.81	0.08

Table O.3. Change in knowledge of nutrition assessment of obesity in a medical nutrition therapy I class by gender

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Male	3	72.0 (7.4)	71.0 (19.6)	-1.0 (16.6)
Female	41	66.4 (10.9)	70.0 (9.6)	3.5 (11.8)

[a]p = 0.39 [b]p = 0.94 [c]p = 0.53

Table O.4. Change in knowledge of nutrition assessment of obesity in a medical nutrition therapy I class by race/ethnicity

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Asian	3	69.9 (9.3)	78.5 (9.9)	8.6 (18.9)
Hispanic	3	53.8 (6.8)	66.7 (17.8)	12.9 (11.6)
Non-Hispanic black or other	4	62.1 (13.3)	66.9 (7.2)	4.8 (16.8)
Non-Hispanic white	34	68.3 (10.3)	70.0 (9.9)	1.7 (10.9)

[a]p = 0.10 [b]p = 0.44 [c]p = 0.38

Table O.5. Change in knowledge of nutrition assessment of obesity in a medical nutrition therapy I class by year in college

	n*	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Third- or fourth-year undergraduate	30	68.4 (9.4)	69.9 (10.2)	1.5 (10.4)
Fifth-year or beyond undergraduate	13	63.5 (13.5)	70.5 (11.0)	6.9 (15.2)

*One student did not provide data
[a]p = 0.18 [b]p = 0.87 [c]p = 0.18

Table O.6. Change in knowledge of nutrition assessment of obesity in a medical nutrition therapy I class by pre-test score above or below the mean

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Pre-test score below the mean	21	57.9 (7.0)	68.0 (10.4)	10.1 (10.5)
Pre-test score above the mean	23	75.0 (5.9)	71.9 (9.9)	-3.1 (9.7)

[a]$p < 0.001$ [b]$p = 0.21$ [c]$p < 0.001$

Table O.7. Clinical nutrition interventions pre-test/post-test question analysis comparing paper-based and online groups (χ^2)

	Full Credit		Partial Credit		No Credit		
	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	P-Value
1. List two environmental factors that may influence eating decisions. (open response)							
Pre-test	21 (91)	21 (92)	2 (9)	2 (9)	0 (0)	0 (0)	1.00
Post-test	19 (83)	22 (96)	3 (13)	1 (4)	1 (4)	0 (0)	0.33
Change in score							0.63
2. List two environmental factors that may influence physical activity decisions. (open response)							
Pre-test	17 (74)	17 (74)	4 (17)	6 (26)	2 (9)	0 (0)	0.30
Post-test	18 (78)	13 (57)	5 (22)	9 (39)	0 (0)	1 (4)	0.23
Change in score							0.17
3. List two psychosocial factors that may influence eating decisions. (open response)							
Pre-test	20 (87)	15 (65)	3 (13)	4 (17)	0 (0)	4 (17)	0.09
Post-test	18 (78)	19 (83)	5 (22)	4 (17)	0 (0)	0 (0)	0.71
Change in score							0.11
4. There can be many behavioral, emotional, or environmental triggers to eat outside of hunger. Which of the following is an emotional trigger to eat? (A and B Only: Before or after a difficult final exam OR Feeling bored or tired and believing that food will help)							
Pre-test	12 (52)	10 (44)	-	-	11 (48)	13 (57)	0.56
Post-test	13 (57)	13 (57)	-	-	10 (44)	10 (44)	1.00
Change in score							0.48
5. Which of the following is a behavioral trigger to eat? (A – Stopping by Starbucks on the way home from school/work every day)							
Pre-test	9 (39)	8 (35)	-	-	14 (61)	15 (65)	0.76
Post-test	11 (48)	8 (35)	-	-	12 (52)	15 (65)	0.37
Change in score							0.18
6. Lindsey recognizes that she often eats although she is not hungry when other people are eating around her. What is a practical way that Lindsey can avoid this trigger to eat something unhealthy? (C – Offer to bring something healthy for everyone to eat)							

	Full Credit		Partial Credit		No Credit		
	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	P-Value
Pre-test	19 (83)	21 (91)	-	-	4 (17)	2 (9)	0.38
Post-test	21 (91)	22 (96)	-	-	2 (9)	1 (4)	0.55
Change in score							0.89
7. An ad campaign, such as Strong4Life's television ads linking childhood obesity to earlier mortality in adulthood, focused on raising awareness of the severe health risks associated with obesity. Which behavior change theory informed this campaign? (B – Health Belief Theory)							
Pre-test	13 (57)	11 (48)	-	-	10 (44)	12 (52)	0.56
Post-test	**8 (35)**	**15 (65)**	**-**	**-**	**15 (65)**	**8 (35)**	**0.039**
Change in score							**0.034**
8. Kalia states that she is visiting the dietitian because her physician said that she needs to lose weight due to risk for diabetes and cardiovascular disease, but she believes that her whole family is heavy and she doesn't see a problem. What is Kalia's stage of change in the Transtheoretical model? (A – Precontemplation)[#]							
Pre-test	23 (100)	23 (100)	-	-	0 (0)	0 (0)	-
Post-test	23 (100)	22 (96)	-	-	0 (0)	1 (4)	0.31
Change in score							0.31
9. Social cognitive theory focuses on the interaction between personal concepts and environmental factors. (A – True)							
Pre-test	20 (87)	22 (96)	-	-	3 (13)	1 (4)	0.30
Post-test	22 (96)	20 (87)	-	-	1 (4)	3 (13)	0.30
Change in score							0.18
10. Raye is planning a dietary intervention in her dorm by raising funds for a "healthy vending machine." Which theory of behavior change informs this environmental cue approach? (D – Social Ecological Model)							
Pre-test	10 (44)	7 (30)	-	-	13 (57)	16 (70)	0.36
Post-test	8 (35))	11 (48)	-	-	15 (65)	12 (52)	0.37
Change in score							0.32
11. What is the reason for using self monitoring in weight management? (open response)							
Pre-test	3 (13)	2 (9)	20 (87)	16 (70)	0 (0)	5 (22)	0.10
Post-test	3 (13)	2 (9)	19 (82)	18 (78)	1 (4)	3 (13)	0.70

	Full Credit		Partial Credit		No Credit		
	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	P-Value
Change in score							0.84
12. Nadia tries to eat healthy to set a good example for her daughters. Is Nadia's motivation autonomous or controlled? (Controlled)							
Pre-test	11 (48)	11 (48)	-	-	12 (52)	12 (52)	1.00
Post-test	15 (35)	13 (57)	-	-	8 (35)	10 (44)	0.55
Change in score							0.80
13. According to Social Determination Theory, clients need support for autonomy, competence, and relatedness. You provide several pamphlets related to healty eating and physical activity and suggest that Dawn should increase her fruit and vegetable intake, walk at least 30 minutes each day, and decrease the number of daily sodas she consumes. Which need are you not supporting? (A – Autonomy)							
Pre-test	9 (39)	10 (44)	-	-	14 (61)	13 (57)	0.77
Post-test	9 (39)	13 (57)	-	-	14 (61)	10 (44)	0.24
Change in score							0.53
14. All of the following are ways to better support the above need except: (D – Providing a checklist of behaviors to change)							
Pre-test	13 (57)	13 (57)	-	-	10 (44)	10 (44)	1.00
Post-test	13 (57)	11 (48)	-	-	10 (44)	12 (52)	0.56
Change in score							0.88
15. Ava has been seeing you for several months for weight management. She initially lost 5% of her body weight but has slowly regained the weight. Her BMI is 36 and she has type 2 diabetes and hypercholesterolemia. Is she a candidate for weight loss surgery? Explain. (open response – Yes, she has metabolic complications with a BMI >35 and has had difficulty losing weight)							
Pre-test	2 (9)	4 (17)	16 (70)	9 (39)	5 (22)	10 (44)	0.21
Post-test	4 (17)	3 (13)	16 (70)	12 (52)	3 (13)	8 (35)	0.18
Change in score							0.26
16. Sara wants to lose 10% of her initial body weight. She decides that she wants to exercise five times a week. Which of the following is the best goal for the behavior? (E – I will walk for 30 minutes Monday through Friday after dinner)							

	Full Credit		Partial Credit		No Credit		
	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	P-Value
Pre-test	2 (9)	4 (17)	-	-	21 (91)	19 (83)	0.38
Post-test	1 (4)	2 (8)	-	-	22 (96)	21 (91)	0.55
Change in score							0.89
17. Kelly is the CEO of a small company. In talking with you, she realizes that she eats out frequently due to her work schedule and traveling 3-4 days per week. She sees this as a problem and vows to cook more dinners at home. Why is Kelly likely or not likely to achieve this goal. (C – Kelly is unlikely to achieve this goal because it may not be realistic given her travel schedule)							
Pre-test	14 (61)	13 (57)	-	-	9 (39)	10 (44)	0.77
Post-test	14 (61)	17 (74)	-	-	9 (39)	6 (26)	0.35
Change in score							0.09
18. What could be a better goal for Kelly? (E – B and C only: Develop strategies to make healthier choices when eating out OR Take healthy snacks during travel)							
Pre-test	23 (100)	20 (87)	-	-	0 (0)	3 (13)	0.07
Post-test	23 (100)	23 (100)	-	-	0 (0)	0 (0)	-
Change in score							0.07
19. Jonathan is 36 years old and has been referred for weight management. You determine that Jonathan needs more information about what is a healthy diet. What is a good free resource that you can share with Jonathan? (open response – Dietary Guidelines for Americans or Choosemyplate.gov)[#]							
Pre-test	23 (100)	22 (96)	0 (0)	1 (4)	0 (0)	0 (0)	0.31
Post-test	22 (96)	23 (100)	0 (0)	0 (0)	1 (4)	0 (0)	0.31
Change in score							0.37
20. Jonathan's estimated needs are 2000 kcal per day, and he usually consumes 50% carbohydrates, 35% fat (14% saturated fat), and 15% protein. He consumes about 2 cups of fruits and/or vegetables each day, almost no whole grain products, and <1 serving of a calcium-rich food each day. Which of the following is an appropriate nutrition intervention for Jonathan? (B – 1, 2, and 3: General healthy diet, nutrition education – priority modifications, fat-modified diet (saturated fat <7% total kcal)							
Pre-test	15 (65)	11 (48)	-	-	8 (35)	12 (52)	0.23
Post-test	13 (57)	16 (70)	-	-	10 (44)	7 (30)	0.36

	Full Credit		Partial Credit		No Credit		
	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	Paper-Based N (%)*	Online N (%)*	P-Value
Change in score							0.31
21s. What outcomes and criteria will be important to measure at Jonathan's follow-up in three months? (D – 2, 3, 4, and 5: Increase in nutrition knowledge as evidenced by changes in dietary habits, decrease in total kcal intake (to recommended 2000 kcal per day), decrease in intake of saturated fat (to <7%), and increase in intake of fruits and vegetables (to recommended number of servings per Dietary Guidelines for Americans)							
Pre-test	3 (13)	2 (9)	-	-	20 (87)	21 (91)	0.64
Post-test	7 (30)	5 (22)	-	-	16 (70)	18 (78)	0.50
Change in score							0.93

*Percentages may not sum to 100 due to rounding

#Items removed from final pre-test/post-test score due to >90% correct at both pre-test and post-test

Table O.8. Change in knowledge of nutrition counseling for clients with obesity in a clinical nutrition interventions class (N = 42)

	Mean	Std. Deviation	Std. Error Mean	P-Value
Pre-test	58.2	10.4	1.61	
Post-test	62.3	9.6	1.48	
Post-test – Pre-test	4.1	9.4	1.45	0.007

Table O.9. Change in knowledge of nutrition counseling for clients with obesity in a clinical nutrition interventions class by gender

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Male	2	46.2 (10.9)	51.9 (8.2)	5.8 (2.7)
Female	40	58.8 (10.1)	62.8 (9.4)	4.0 (9.6)

[a]p = 0.10 [b]p = 0.12 [c]p = 0.80

Table O.10. Change in knowledge of nutrition counseling for clients with obesity in a clinical nutrition interventions class by race/ethnicity

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Asian	3	53.8 (10.2)	61.5 (16.8)	7.7 (17.6)
Hispanic	4	57.7 (8.3)	60.6 (7.3)	2.9 (14.9)
Non-Hispanic black or other	3	59.0 (14.6)	61.5 (11.5)	2.6 (8.9)
Non-Hispanic white	32	58.5 (10.7)	62.6 (9.4)	4.1 (8.3)

[a]p = 0.91 [b]p = 0.98 [c]p = 0.91

Table O.11. Change in knowledge of nutrition counseling for clients with obesity in a clinical nutrition interventions class by year in college

	n*	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Third- or fourth-year undergraduate	30	58.8 (9.9)	63.2 (8.7)	4.4 (9.2)
Fifth-year or beyond undergraduate	11	57.3 (12.1)	60.1 (12.2)	2.8 (10.8)

*One student did not provide data
[a]p = 0.70 [b]p = 0.38 [c]p = 0.63

Table O.12. Change in knowledge of nutrition counseling for clients with obesity in a clinical nutrition interventions class by pre-test score above or below the mean

	n	Pre-test[a] Mean (%) (Std. Deviation)	Post-test[b] Mean (%) (Std. Deviation)	Change in Score[c] Mean (%) (Std. Deviation)
Pre-test score below the mean	22	49.8 (6.5)	58.0 (8.4)	8.2 (8.1)
Pre-test score above the mean	20	67.3 (4.2)	66.9 (8.8)	-0.4 (8.9)

[a]$p < 0.001$ [b]$p = 0.002$ [c]$p = 0.002$