ORIGINAL ARTICLE

An Educational Model to Prepare Indian Medical Students for Providing Dietary Counseling to Patients with Metabolic Syndrome

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Background: Metabolic syndrome is a highly prevalent condition in India, requiring effective lifestyle and dietary counseling as a cornerstone of management. This study aimed to develop and evaluate an educational model incorporating kitchen classes to prepare Phase III MBBS students to competently counsel patients with metabolic syndrome regarding dietary modification.

Method: A cross-sectional, interventional mixed-method study was conducted among 100 Phase III MBBS students at a medical college in North India. The intervention included didactic lectures, interdisciplinary sessions with anatomy, physiology, and biochemistry departments, dietician-led kitchen classes using pre-recorded cooking demonstrations, and role-play counseling exercises. Thirty students were randomly selected using the chit method for assessment before and after the intervention. Competence was evaluated through Objective Structured Clinical Examination (OSCE) and Objective Structured Practical Examination (OSPE) scores, analyzed using Wilcoxon signed rank test. Open-ended qualitative feedback was analyzed thematically.

Results: Mean OSCE and OSPE scores improved from 13.45 to 14.64 ($p = 0.007$) and 15.72 to 19.94 ($p = 0.03$), respectively. Students reported that kitchen classes enhanced understanding of portion sizes, hidden dietary fats and sugars, and practical applicability of nutrition knowledge. Role-play sessions improved confidence and empathy in patient communication. Thematic analysis revealed three domains: integration of theory with practice, improved counseling competence, and positive impact on personal health attitudes.

Conclusion: A multidisciplinary, simulation-based curriculum centered on dietician-led kitchen classes significantly improved medical students' competence and confidence in dietary counseling for metabolic syndrome and may improve practical nutrition skills.

Keywords: Metabolic syndrome; Medical education; Dietary counseling; Kitchen classes; OSCE; OSPE; Competency-based curriculum

نموذج تعليمي لإعداد طلاب الطب الهنود لتقديم المشورة الغذائية للمرضى الذين يعانون من متلازمة التمثيل الغذائي

الخلفية: تُعد متلازمة التمثيل الغذائي حالة شائعة للغاية في الهند، وتتطلب تقديم مشورة فعالة بشأن نمط الحياة والنظام الغذائي باعتبار ذلك ركيزة أساسية للعلاج. هدفت هذه الدراسة إلى تطوير وتقييم نموذج تعليمي يتضمن دروساً عملية في المطبخ لإعداد طلاب المرحلة الثالثة من برنامج بكالوريوس الطب والجراحة (MBBS) لتقديم المشورة بكفاءة للمرضى المصابين بمتلازمة التمثيل الغذائي حول تعديل النظام الغذائي.

الطريقة: أُجريت دراسة مقطعية وتدخلية تعتمد على المناهج المختلطة (الكمية والنوعية) شملت ١٠٠ طالب من طلاب المرحلة الثالثة في كلية طب بشمال الهند. وتضمن التدخل محاضرات نظرية، وجلسات مشتركة بين التخصصات (بالتعاون مع أقسام التشريح وعلم وظائف الأعضاء والكيمياء الحيوية)، ودروساً في المطبخ بإشراف أخصائي تغذية باستخدام عروض طهي مسجلة مسبقاً، وتمارين محاكاة (لعب الأدوار) لتقديم المشورة. تم اختيار ثلاثين طالباً عشوائياً (باستخدام طريقة القرعة) للتقييم قبل وبعد التدخل. وجرى تقييم الكفاءة من خلال درجات "الامتحان السريري المنظم متعدد المحطات" (OSCE) و"الامتحان العملي المنظم متعدد المحطات" (OSPE)، وتم تحليل النتائج باستخدام اختبار "ويلكوكسون" للرتب الموقعة (Wilcoxon signed-rank test)، كما تم تحليل الملاحظات النوعية المفتوحة وفقاً للمواضيع (التحليل الموضوعي).

النتائج: تحسنت متوسطات درجات OSCE وOSPE من ١٣,٤٥ إلى ١٤,٦٤ (قيمة $p = 0.007$) ومن ١٥,٧٢ إلى ١٩,٩٤ (قيمة $p = 0.03$) على التوالي. وأفاد الطلاب بأن دروس المطبخ عززت فهمهم لأحجام الحصص الغذائية، والدهون والسكريات الخفية في الأطعمة، وإمكانية التطبيق العملي للمعرفة الغذائية. كما ساهمت جلسات لعب الأدوار في تعزيز الثقة والتعاطف أثناء التواصل مع المرضى. وكشف التحليل الموضوعي عن ثلاثة محاور: الربط بين النظرية والتطبيق، وتحسن كفاءة تقديم المشورة، والأثر الإيجابي على المواقف الشخصية تجاه الصحة.

الخلاصة: أدى المنهج متعدد التخصصات والقائم على المحاكاة -والذي يرتكز على دروس المطبخ بإشراف أخصائي تغذية- إلى تحسين ملموس في كفاءة طلاب الطب وثقتهم في تقديم المشورة الغذائية لحالات متلازمة التمثيل الغذائي، كما قد يساهم في تحسين المهارات العملية في مجال التغذية.

الكلمات المفتاحية: متلازمة التمثيل الغذائي؛ التعليم الطبي؛ المشورة الغذائية؛ دروس المطبخ؛ OSCE؛ OSPE؛ منهج قائم على الكفاءة

میٹابولک سنڈروم کے مریضوں کو غذائی مشاورت فراہم کرنے کے لیے ہندوستانی طبی طلبہ کو تیار کرنے کے لیے ایک تعلیمی ماڈل

پس منظر: میٹابولک سنڈروم ہندوستان میں ایک بہت زیادہ مروجہ حالت ہے، جس کے لیے موثر طرز زندگی اور غذائی مشاورت کی ضرورت ہوتی ہے جو کہ انتظام کی بنیاد ہے۔ اس مطالعہ کا مقصد ایک تعلیمی ماڈل تیار کرنا اور اس کا جائزہ لینا تھا جس میں باورچی خانے کی کلاسیں شامل ہوں تاکہ فیز III MBBS کے طلباء کو میٹابولک سنڈروم کے مریضوں کو خوراک میں تبدیلی کے حوالے سے قابلیت سے مشورہ دیا جا سکے۔

طریقہ: شمالی ہندوستان کے ایک میڈیکل کالج میں فیز III MBBS کے ۱۰۰ طلباء کے درمیان ایک کراس سیکشنل، مداخلتی مخلوط طریقہ کا مطالعہ کیا گیا۔ مداخلت میں تدریسی لیکچرز، انٹاومی، فزیالوجی، اور بائیو کیمسٹری کے شعبوں کے ساتھ بین الضابطہ سیشن، پہلے سے ریکارڈ شدہ کھانا پکانے کے مظاہروں کا استعمال کرتے ہوئے غذائی ماہرین کی زیرقیادت باورچی خانے کی کلاسیں، اور رول پلے کونسلنگ کی مشقیں شامل تھیں۔ مداخلت سے پہلے اور بعد میں تشخیص کے لیے چٹ کے طریقہ کار کا استعمال کرتے ہوئے تیس طلباء کو تصادفی طور پر منتخب کیا گیا تھا۔ قابلیت کا اندازہ آبجیکٹو سٹرکچرڈ کلینیکل ایگزامینیشن (OSCE) اور آبجیکٹیو سٹرکچرڈ پریکٹیکل ایگزامینیشن (OSPE) سکور کے ذریعے کیا گیا، جس کا تجزیہ Wilcoxon کے دستخط شدہ رینک ٹیسٹ کے ذریعے کیا گیا۔ اوپن اینڈ کوالٹی فیڈ بیک کا تھیمیٹک طور پر تجزیہ کیا گیا۔

نتائج: اوسط OSCE اور OSPE کے اسکور بالترتیب ۱۳٫۳۵ سے ۱۳٫۶۳ ($p = 0.007$) اور ۱۵٫۷۲ سے ۱۹٫۹۳ ($p = 0.03$) تک بہتر ہوئے۔ طلباء نے بتایا کہ کچن کی کلاسوں نے حصے کے سائز، پوشیدہ غذائی چکنائی اور شکر، اور غذائیت کے علم کے عملی اطلاق کی سمجھ میں اضافہ کیا۔ رول پلے سیشنز نے مریض کے مواصلات میں اعتماد اور ہمدردی کو بہتر بنایا۔ موضوعاتی تجزیہ نے تین ڈومینز کا انکشاف کیا: تھیوری کا پریکٹس کے ساتھ انضمام، مشاورت کی بہتر صلاحیت، اور ذاتی صحت کے رویوں پر مثبت اثرات۔

نتیجہ: غذائی ماہرین کی زیرقیادت باورچی خانے کی کلاسوں پر مرکوز ایک کثیر الضابطہ، نقلی نصاب نے میٹابولک سنڈروم کے لیے غذائی مشاورت میں طبی طلباء کی قابلیت اور اعتماد کو نمایاں طور پر بہتر کیا اور عملی غذائیت کی مہارتوں کو بہتر بنایا۔

کلیدی الفاظ: میٹابولک سنڈروم؛ طبی تعلیم؛ غذائی مشاورت؛ کچن کلاسز؛ او ایس سی؛ او ایس پی ای؛ قابلیت پر مبنی نصاب

مدل آموزشی برای آماده‌سازی دانشجویان پزشکی هند برای ارائه مشاوره غذایی به بیماران مبتلا به سندروم متابولیک

زمینه و هدف: سندروم متابولیک یک بیماری شایع در هند است که نیاز به مشاوره مؤثر در سبک زندگی و رژیم غذایی دارد. این مطالعه با هدف طراحی و ارزیابی یک الگوی آموزشی مبتنی بر کلاس‌های آشپزخانه انجام شد تا دانشجویان سال سوم پزشکی را برای مشاوره به بیماران سندروم متابولیک در زمینه اصلاح رژیم غذایی آماده کند.

روش: مطالعه مداخله‌ای مقطعی با روش‌های ترکیبی بین ۱۰۰ دانشجوی سال سوم پزشکی در یک دانشکده پزشکی در شمال هند انجام شد. مداخله شامل سخنرانی‌های آموزشی، جلسات بین رشته‌ای با بخش‌های آناتومی، فیزیولوژی و بیوشیمی، کلاس‌های آشپزخانه تحت هدایت متخصص تغذیه با استفاده از نمایش‌های آشپزی از پیش ضبط شده و تمرین‌های مشاوره‌ای نقش‌آفرینی بود. سی دانشجو به طور تصادفی با استفاده از روش قرعه کشی برای ارزیابی قبل و بعد از مداخله انتخاب شدند. شایستگی آنان با استفاده از نمرات آزمون بالینی ساختارمند عینی (OSCE) و آزمون عملی ساختارمند عینی (OSPE) ارزیابی و داده ها با آزمون ویلکاکسون تجزیه و تحلیل شد. بازخوردهای کیفی باز به صورت تحلیل موضوعی بررسی شدند.

یافته‌ها: میانگین نمرات OSPE از ۱۳/۴۵ به ۱۴/۶۴ ($p = 0.007$) و OSCE از ۱۵/۷۲ به ۱۹/۹۴ ($p = 0.03$) افزایش یافت. کلاس‌های آشپزخانه درک از اندازه وعده‌های غذایی، چربی‌ها و قندهای پنهان در رژیم غذایی و کاربرد عملی دانش تغذیه را افزایش داد. جلسات ایفای نقش، اعتماد به نفس و همدلی با بیمار را بهبود بخشید. تجزیه و تحلیل موضوعی سه حوزه ادغام تئوری با عمل، بهبود شایستگی مشاوره و تأثیر مثبت بر نگرش‌های سلامت شخصی را نشان داد.

نتیجه گیری: برنامه درسی چند رشته‌ای و مبتنی بر شبیه‌سازی با محوریت کلاس‌های آشپزخانه تحت نظر متخصص تغذیه، شایستگی و اعتماد به نفس دانشجویان را در مشاوره رژیم غذایی برای سندروم متابولیک افزایش داد و ممکن است مهارت‌های عملی آنان در حوزه تغذیه را بهبود بخشد.

واژه های کلیدی: سندروم متابولیک؛ آموزش پزشکی؛ مشاوره رژیم غذایی؛ کلاس‌های آشپزخانه؛ OSCE؛ OSPE؛ برنامه درسی مبتنی بر شایستگی

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INTRODUCTION

Metabolic syndrome (MetS)—a cluster of central obesity, hypertension, dyslipidemia, and impaired glucose metabolism—strongly elevates the risk of cardiovascular disease and type 2 diabetes. In India, the prevalence of MetS is rising sharply, particularly among adolescents, due to changes in dietary habits and lifestyle (1).

While most of the literature available focuses on adult populations, data from the INDIAB study show metabolic risk factors affecting up to 70% of Indians—highlighting the urgency of early dietary interventions (2).

Despite the growing need, medical curricula in India still lag in delivering practical nutrition education. Medical students usually learn about nutrition in a theoretical, fragmented manner—away from clinical relevance and insufficiently emphasized compared to traditional subjects (3).

A cross-sectional study revealed less than half of final-year students and interns—about 45%—felt competent in assessing patients' dietary habits or advising on nutrient-rich diets (4).

Globally, educators appreciate the lacuna in nutrition training as a persistent barrier to effective dietary counseling. Recent systematic reviews advocate for competency-based, experiential learning models that integrate hands-on nutritional assessment, interactive sessions, and interprofessional collaboration to build competency and confidence among medical students (5, 6).

Drawing upon these insights, this study introduces a structured educational model tailored for the Indian medical context. The model combines evidence-based nutrition knowledge, skill-building in dietary counseling, simulation exercises, and multidisciplinary collaboration. Its aim is to cultivate Indian medical graduates who are not only knowledgeable but also confident and capable in guiding patients with metabolic syndrome through effective dietary changes.

The aim of the study was to enable phase III MBBS students to competently and empathetically counsel patients with metabolic syndrome about dietary modification in a simulated environment.

Specifically, the objectives of the study were that the phase III MBBS students must interpret laboratory reports of a patient with metabolic syndrome in an Objective Structured Practical Examination (OSPE), plan individualized dietary modifications for a standardized patient with metabolic syndrome, covering macronutrient distribution, portion control, and culturally appropriate food choices in line with current dietary guidelines, and counsel a simulated patient with metabolic syndrome on dietary modification, demonstrating empathetic, understanding, and non-judgmental communication, as assessed by a structured checklist in an Objective Structured Clinical Examination (OSCE).

METHODS

Design and setting(s)

This was a cross-sectional interventional study with a mixed-method design conducted at a medical college in North India among Phase III MBBS students.

Participants and sampling

A total of 100 medical students were included using the total enumeration sampling method.

Intervention program

Table 1 shows the structured educational program designed collaboratively with the Departments of Anatomy, Physiology, Biochemistry, Psychiatry, and Dietetics. The program aimed to enhance medical students' competence in dietary counseling for patients with metabolic syndrome.

Teaching–learning methodology

The program was delivered through a combination of Large Group Interactive (LGI) sessions, role plays, kitchen demonstrations, and Objective Structured Clinical Examinations (OSCE). Sessions covered anatomy, physiology, and biochemistry relevant to metabolic syndrome; interpretation of laboratory reports; principles of dietary modification; and counseling techniques.

Kitchen classes

In addition to lectures, kitchen classes were conducted by a hospital dietitian using pre-recorded demonstration videos. These videos illustrated the practical aspects of cooking, highlighting the quantity of ingredients commonly used in Indian diets (e.g., oil or ghee used in paratha preparation, sugar added in kheer). This allowed students to visually appreciate the contribution of dietary ingredients to caloric load and better understand how to guide patients in modifying traditional recipes for healthier outcomes. Kitchen classes represented the most innovative component of the program, bridging theoretical nutrition knowledge with real-world practices.

Data collection methods

All 100 students underwent pre-test and post-test assessments covering knowledge and application-based questions. Although all 100 students participated in the intervention, a detailed competency assessment through OSCE and OSPE was conducted in a randomly selected sample of 30 students. This sampling approach was adopted because conducting multiple OSCE/OSPE stations for the entire cohort was not feasible due to time, faculty, and resource constraints. Random selection was performed using the chit method to minimize selection bias. Their skills were assessed before and after the intervention using OSCE and OSPE. The OSCE and OSPE were developed and validated as per Competency-based Medical Education (CBME) guidelines to assess knowledge, skills, and

Table 1. Detailed schedule of the multidisciplinary nutrition education intervention: teaching methodology, topics, faculty involvement, and session duration

Sr. No.	Teaching Methodology	Topic	Teacher	Duration
1	LGI/OSCE/OSPE	Introduction to study, relevance, methodology, and pretest	Principal Investigator	60 min
2	LGI	Anatomy of pancreas, liver, adipose tissue, and visceral fat	Assistant Professor, Anatomy	20 min
3	LGI	Physiology of pancreas, liver, adipose tissue, visceral fat, and blood pressure	Professor, Physiology	20 min
4	LGI	Biochemistry of sugar and fat digestion with metabolism; Introduction to metabolic syndrome	Assistant Professor, Biochemistry	30 min
5	LGI	Interpretation of lipid profile and dietary component impact	Assistant Professor, Biochemistry	30 min
6	LGI	Introduction to healthy diet in metabolic syndrome	Dietitian, Hospital	30 min
7	LGI	Planning diet charts in different cases with examples	Dietitian, Hospital	60 min
8	LGI/Kitchen class	Impact of cooking methods and demonstration of dishes with ingredient quantification (oil/ghee, sugar, etc.)	Dietitian, Hospital	60 min
9	LGI	Planning diet charts in different cases with examples	Dietitian, Hospital	60 min
10	LGI/Role play	Basics of counseling with examples	Assistant Professor, Psychiatry	60 min
11	OSCE	Post-test and feedback	Principal Investigator	60 min

LGI: Large Group Interactive sessions, OSCE: Objective Structured Clinical Examinations, OSPE: Objective Structured Practical Examination

attitudes. Content validity was ensured through expert review by faculty members from relevant disciplines, and a blueprint was prepared to align each station with predefined learning objectives and competencies. Construct validity was assessed by comparing performance between two groups of students with different levels of clinical exposure. Criterion validity was evaluated by correlating OSCE/OSPE scores with internal assessment and theory examination marks. To establish reliability, each station employed structured checklists and global rating scales. Examiners were oriented prior to assessment to minimize subjectivity. Internal consistency and inter-rater reliability were calculated using Cronbach's alpha (0.81) and the intra-class correlation coefficient (0.72), respectively. Feasibility and acceptability were assessed using structured feedback from students and examiners regarding organization, clarity, and overall conduct of the examination. Table 2 shows the Objective–Activity–Assessment mapping.

Table 2. Objective–Activity–Assessment mapping

Objective	Teaching–Learning Activity	Highlight / Innovation	Assessment Method
1. Interpret the laboratory reports of a patient with metabolic syndrome	LGI on lipid profile interpretation and biochemistry of fat/sugar metabolism	Case-based discussion of lab values	Pre-test, post-test, OSPE
2. Plan dietary modification in a patient of metabolic syndrome	LGIs on healthy diet, diet chart planning, and Kitchen Classes (video demonstrations by dietician showing actual ingredient quantities e.g., oil in paratha, sugar in kheer)	Kitchen Classes – bridging theoretical nutrition with real-world cooking practices	Post-test case scenarios, OSCE
3. Counsel a patient of metabolic syndrome about dietary modification empathetically and nonjudgmentally	LGI/Role play on basics of counseling with examples; simulated counseling in OSCE	Use of psychiatry faculty input for empathy and communication	OSCE counseling station, feedback from standardized patient

LGI: Large Group Interactive sessions, OSCE: Objective Structured Clinical Examinations, OSPE: Objective Structured Practical Examination

In addition to quantitative assessment, qualitative feedback was obtained to capture students' perceptions of the intervention. After completion of the program, a subgroup of 30 students (randomly selected using the chit method) were asked to provide open-ended written feedback on blank sheets of paper. They were encouraged to freely express their reflections on the usefulness, relevance, and applicability of the sessions, including the lectures, role-plays, OSCE/OSPE practice, and especially the kitchen classes.

The feedback was collected anonymously to

minimize response bias and encourage honest reflection.

Data analysis

A total of 100 MBBS Phase III students participated in the intervention program. Among them, 30 students were randomly selected for pre- and post-intervention assessment using OSCE and OSPE. Owing to the non-normal distribution of the data, comparisons between pre-intervention and post-intervention scores were performed using the Wilcoxon signed-rank test. Mean scores are presented for descriptive purposes.

Open-ended written feedback was obtained from all 30 randomly selected students and analyzed using thematic analysis. Two independent reviewers read through all responses multiple times, performed open coding, and grouped similar codes into categories. These categories were then refined into broader themes that represented the collective experiences and perceptions of the students. Any discrepancies in coding were resolved by discussion until consensus was reached. Representative excerpts were retained to illustrate key themes. Table 3 shows the Thematic Analysis of Student Feedback.

RESULTS

Figure 1 presents the comparison of pre-intervention and post-intervention median OSCE and OSPE scores among the 30 randomly selected students. Wilcoxon signed-rank test was used for analysis. The median OSCE score increased from 13.0 (IQR: 12.0–15.0) in the pre-test to 15.0 (IQR: 13.0–16.0) in the post-test, demonstrating a statistically significant improvement ($p = 0.02$). Similarly, the median OSPE score improved from 16.0 (IQR: 14.0–18.0) before the intervention to 20.0 (IQR: 19.0–20.0) after the intervention, with the difference also being statistically significant ($p = 0.04$). These findings indicate that participants' performance improved significantly following the intervention. Mean scores are presented for descriptive purposes. The mean OSCE score increased from 13.45 before the intervention to 14.64 after the intervention while the mean OSPE score increased from 15.72 to 19.94. The improvements were statistically significant as determined by the Wilcoxon signed-rank test (OSCE: $p = 0.007$; OSPE: $p = 0.03$), indicating enhanced competence in laboratory report interpretation, dietary planning, and dietary counseling following participation in the multidisciplinary educational program.

Qualitative feedback from the 30 participating students revealed five major themes (Table 3). The theme Integration of Theory with Practice reflected students' enhanced ability to apply theoretical concepts of nutrition and metabolic syndrome in clinical settings, particularly in interpreting laboratory reports and understanding disease consequences. Kitchen Classes as Experiential Learning theme highlighted the value of hands-on learning experiences, with students expressing greater awareness of the role of diet in disease management and increased confidence in adopting and recommending healthy dietary practices. The theme Behavior Change and Personal Impact suggested that the intervention influenced students' own dietary attitudes and lifestyle choices, motivating them to implement healthier habits and promote such changes among family members. Active Learning through Role Play and Counseling theme demonstrated improved confidence, communication skills, and comfort in patient counseling through experiential learning. Finally, the theme Overall Experience and Suggestions reflected high levels of engagement and satisfaction with the program, while also identifying areas for improvement, including longer session duration and better integration of some teaching components.

Table 3 . Thematic Analysis of Student Feedback (n = 30)

Theme	Representative Student Quotes
Integration of Theory with Practice	"Although I knew the theory earlier also, now I learned its practical application." "I can confidently interpret the lipid profile of any patient in terms of probable consequences."
Kitchen Classes as Experiential Learning	"Amazed after knowing that diet plays such a big role in the management of complex diseases like metabolic syndrome." "Ideas on preparing healthy stuff were the best — now I know how to apply it at home." "I will try one recipe with my family, hope they love it."
Behavior Change and Personal Impact	"Now I will talk to my father about correcting his dietary habits." "My view towards a healthy diet is totally changed." "I will start reducing fried food after attending these sessions."
Active Learning through Role Play and Counseling	"I enjoyed a lot after playing the character of doctor, wish I could be a doctor like this in future." "Role play makes us learn in real time." "Counseling practice helped me overcome shyness while speaking in front of peers."
Overall Experience and Suggestions	"The program changed my outlook towards food and health completely." "Sessions were very engaging, but I wish the duration was longer." "Sometimes the information from lectures and dietician overlapped."

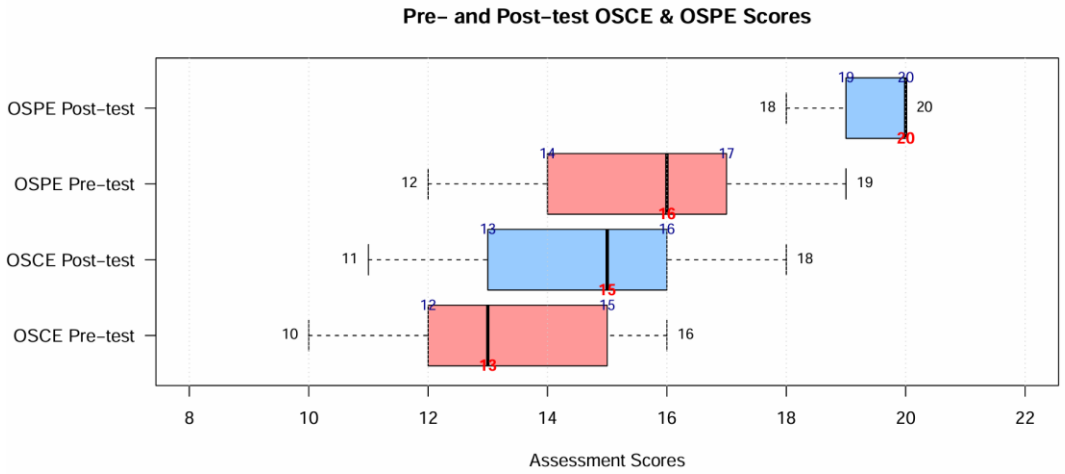

Figure 1. Box and Whisker Plot of Median Pre and Post OSCE and OSPE Scores
Objective Structured Clinical Examinations (OSCE), Objective Structured Practical Examination (OSPE)

DISCUSSION

This study demonstrates that integrating kitchen classes into a structured nutrition curriculum significantly enhanced Phase III MBBS students' competence in interpreting metabolic syndrome lab reports, planning dietary modifications, and delivering empathetic, non-judgmental counseling. The OSCE/OSPE scores improved significantly and qualitative feedback highlighted kitchen classes as the most impactful innovation.

Global curriculum gaps were also mentioned in one of the publications in Lancet by Crowley, Jennifer et al. (3), titled The Lancet Planetary Health: Despite the increasing prevalence of diet-related diseases, current medical education programs inadequately prepare students to deliver effective nutritional care. It has been observed that, although nutrition is fundamental to maintaining a healthy lifestyle, medical students receive insufficient training and support to provide evidence-based nutrition counseling. Strengthening medical education in this domain requires institutional commitment to integrate mandatory nutrition education into the curriculum, the development of standardized nutrition competencies to guide knowledge and skill acquisition, and the allocation of dedicated funding to promote innovative curriculum development in nutrition science.

Need for this type of study was also emphasized by Olivia Kunitsky et al., where they mentioned that there is a growing need to enhance medical nutrition education to prepare future physicians capable of effectively addressing patients' nutritional requirements (7). Researchers have identified key barriers that impede the advancement of nutrition training in medical curricula, proposed evidence-based strategies for its improvement, and delineated essential roles and responsibilities necessary for the successful integration and implementation of nutrition education within medical programs.

In an evidence review by David M. Eisenberg et al., it was found that the identified competencies encompassed several nutrition-related domains, including foundational nutrition knowledge, nutritional assessment and diagnosis, communication skills, public health perspectives, interprofessional collaboration in patient support and management of condition-specific nutrition needs, as well as criteria for referral to specialists (8). Notably, 36 panelists (97%) recommended that these nutrition competencies be formally evaluated within medical licensing and board certification examinations.

Like our study, Christopher R D'Adamo et al., found that a single session of culinary medicine integrated into the core medical curriculum was found to be feasible and resulted in significant improvements in medical students' nutrition knowledge, practical skills, attitudes, and self-efficacy in providing nutritional counseling to patients (9).

Similarly, feedback from students of first cohort of a novel culinary medicine course at Stanford University, school of medicine, by Michelle E Hauser shows that the students participating demonstrated significant enhancements in their attitudes, knowledge, and behaviors related to healthy cooking and meal planning compared with the control group (10).

One more article by Jacqueline Tan et al., also reported a marked rise in interest toward incorporating hands-on culinary medicine programs as educational tools, demonstrating their feasibility and effectiveness in implementation (11). Compared with traditional didactic teaching, these programs were associated with notable improvements in students' nutritional knowledge, practical skills, and counseling abilities. The

authors further suggested that their review support the recognition of culinary medicine as a legitimate and effective approach for delivering nutrition education within medical curricula.

Similar to our study, Solenn Thircuir et al., in their study highlighted that, despite differences in medical education systems, students from both France and the United States expressed similar concerns and expectations—emphasizing that nutrition education should be integrated into the curriculum and delivered in an engaging manner (12). It further underscored the need for hands-on, system-based, epistemological, and multidisciplinary approaches to strengthen the overall structure of medical training. These findings align closely with the feedback obtained from our students.

Supporting our objective, a community medicine exercise by P Aravind Gandhi et al., in New Delhi revealed that group-based cooking, meal planning, and demonstration activities were shown to enhance students' understanding of nutrition concepts and the practical challenges associated with dietary implementation—findings that closely parallel our own kitchen-based teaching approach (13).

Likewise, interactive novel online nutrition module by Pinyu Chen et al., mentioned that integrating interactive exercises, multimedia resources, and case-based scenarios led to enhanced knowledge retention, with improvements sustained up to two months following the training (14).

Similar to our study, confidence and preparedness outcomes in a study done by Ammore et al., in Ghana, nutritional preparedness among clinical medical students increased from 38% to 65% following the intervention, with this improvement maintained over a four-week period (5).

A scoping review by Courtney Newman et al., illustrated that as culinary education programs expand across academic institutions, standardizing curricular components, program structures, best practices, and assessment methodologies will be essential to ensure quality, sustainability, and maximal impact on population health (15).

Similar to our study, Heather R Christensen et al., in their case-control study, an overall positive response was reported, with the most influential learning component identified as actively engaging with the assigned diet (16). While adherence to the diet varied among participants, the cohort collectively exhibited greater confidence in providing nutrition counseling in clinical settings compared with non-participant peers. Additionally, participants reported an enhanced appreciation for the significance of physician efficacy and the physician–patient relationship within the broader context of nutrition in patient care, relative to the control group.

Overall, the literature consistently supports experiential, hands-on nutrition education as superior to passive lecture formats. Our findings corroborate this, especially given the cultural relevance of Indian kitchen demonstrations.

CONCLUSION

A multidisciplinary, simulation-supported nutrition curriculum enhanced Phase III MBBS students' ability to interpret laboratory reports, plan individualized dietary modifications, and provide dietary counseling for patients with metabolic syndrome. The integration of experiential learning strategies, particularly live cooking demonstrations and simulated patient interactions, facilitated the translation of nutrition knowledge into practical clinical skills. Incorporating such innovative approaches into undergraduate medical education may better prepare future physicians to address nutrition-related aspects of patient care.

Ethical Considerations:

This study was approved by institutional ethical committee Subharti Medical College, Meerut (SMC/UECM/2021/339/179).

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