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Impact of a Nutrition and Diabetes Continuing Education Program on Primary Care Provider's Knowledge, Attitude, and Clinical Practice

Daniel J Kahn[1], Jane L Hubbard[2], Stephen Dunn[3], Alex Hoyt[1]

[1]School of Nursing, MGH Institute of Health Professions, Boston, MA, USA; [2]Metabolism & Nutrition Research, Massachusetts General Hospital Translational & Clinical Research Center, Boston, MA, USA; [3]Medical Education, Fenway Community Health Center, Boston, MA, USA

Correspondence: Daniel J Kahn, MGH Institute of Health Professions, 36 First Ave, Boston, MA, 02129, USA, Email dkahn@mghihp.edu

Purpose: Diet/nutrition is the first-line non-pharmacological therapy in the treatment of diabetes. Diet/nutrition counseling is infrequently provided by primary care providers (PCPs), who have limited nutrition education in both medical and advanced practice provider curricula. This quality improvement project aimed to improve knowledge and attitude, and frequency of diet/nutrition counseling by PCPs among patients with uncontrolled diabetes (glycosylated hemoglobin A1c ≥8%), by providing an online continuing medical education (CME) program on diabetes diet/nutrition.

Methods: At a community health center in New England, PCPs attended a live 50-minute online CME program that was developed internally, which taught PCPs current diet/nutrition guidelines and recommendations related to diabetes. Knowledge was assessed prior to and two weeks following the program, utilizing a 10-question tool, the Nutrition Management of Diabetes Assessment (NMDA). Similarly, attitude was evaluated using two subscales of the Nutrition in Patient Care Survey (NIPS): Nutrition in routine care and Physician efficacy. Chart audits of patients with uncontrolled diabetes were evaluated to assess PCPs documentation of diet/nutrition counseling four weeks prior to and six weeks following the CME program.

Results: In September 2023, PCPs (n = 29) completed the CME program. There was an improvement in knowledge in the NMDA amongst PCPs (36% difference, $p < 0.001$). Attitude scores from two subscales of the NIPS were evaluated and both showed improvement, however only *physician efficacy* was significant (15% difference, $p < 0.01$). There was a positive difference in the trend of diet/nutrition counseling after the education program ($p < 0.05$).

Conclusion: An online CME program improved diabetes diet/nutrition knowledge and attitude of PCPs and improved counseling practices for patients living with uncontrolled diabetes. The education program provided PCPs current standards of care guidelines/recommendations, which they can utilize when counseling patients with diabetes. PCPs would benefit from dedicated continuing education programs regarding diet/nutrition therapy for chronic illnesses.

Keywords: diabetes, nutrition, medical education, nutrition education, primary care provider

Introduction

Nutrition counseling for patients with diabetes is a widely recommended primary care service. In 2015, the US Preventive Services Task Force (USPSTF) provided a Grade B recommendation that clinicians offer or refer patients with abnormal blood glucose levels to intensive behavioral counseling interventions to promote a healthful diet and physical activity.[1]

According to the *Standards of Care in Diabetes* set forth by the American Diabetes Association (ADA), diabetes self-management education and support, which includes nutrition counseling, should be provided yearly and/or when not meeting targeted goals.[2] These recommendations are made on the evidence that Primary Care Providers (PCPs) are effective health counselors and when PCPs provide nutrition and lifestyle counseling to patients with diabetes, there is a decrease in morbidity and mortality. Among patients who receive monthly or more lifestyle counseling, the 10-year

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cumulative incidence rate of a cardiovascular (CV) event (eg heart attack or stroke) or death was 33.0% compared with 38.1% for less than monthly counseling.[3]

Primary care is usually a patient's first contact with the health care system and provides continuity, coordination, and comprehensive services.[4] It is within the primary care office setting where PCPs have an opportunity to improve the management and outcomes of patients living with diabetes. Patients look to PCPs to gain insightful recommendations to improve their health through diet and nutrition[5]. However, inadequate education and training may contribute to low rates of provider initiated counseling[6]. Studies have shown that there is a positive impact on physician knowledge when continuing medical education (CME) programs incorporate diet/lifestyle within its curricula.[7–9] Lee et al found that after completing CME sessions, the counseling knowledge of PCPs improved 45%, the self-reported frequency of counseling increased 23%, and their diabetic patient's glycosylated hemoglobin A1c (HbA1c) dropped 1.2% compared to baseline.[10] Therefore, we can infer that CME does improve PCPs knowledge and performance while positively affecting clinical outcomes.

Despite the evidence of its effectiveness, nutrition counseling or referral by PCPs are often lacking in the primary care setting. Nutrition counseling or referral for patients with diabetes occurred in about a third of visits for episodic health complaints.[11] The proportion of visits in which diet counseling occurred has not improved over time. National estimates for diet counseling among patients with diabetes in primary care were 27% in 2005 and 21% in 2015.[12] Counseling behavior is associated with the quantity of nutrition education[13], yet nutrition education is lacking in medical[14] and advanced practice provider (APP) curricula.[15,16]

In early 2024, chart audits were completed at a community health center (CHC) in Massachusetts, USA, to evaluate the frequency in which diet/nutrition counseling or referral was delivered to patients with uncontrolled diabetes. The CHC discovered that counseling or referral was provided to less than 15% of patients with uncontrolled diabetes. The National Committee for Quality Assurance maintains the Healthcare Effectiveness Data and Information Set (HEDIS), which are national standards that look towards performance improvement across various chronic health conditions. According to HEDIS, HbA1c >8% is considered uncontrolled.[17] The Quality Improvement Management team at the CHC requested the lead author to develop a single-course CME program focusing on nutrition and diabetes to be presented to its PCPs since the CHC does not have a Registered Dietitian/Nutritionists (RDN) on staff. This project had two specific aims:

Aim 1: To measure PCPs knowledge pertaining to the dietary and nutritional guidelines and recommendations for patients living with diabetes;

Aim 2: To increase the frequency of which PCPs document either diet/nutrition counseling or referral to patients with uncontrolled diabetes after completing an interactive online CME program.

The authors believe this CME program was unique compared to other diabetes nutrition-focused courses. Participants engaged in an interactive Zoom© program that provided up-to-date content related to diabetes diet/nutrition. There are several diet/meal plans that have been shown to improve HbA1c values in patients with diabetes.[18] This program educated PCPs on the Low-Carbohydrate Diet, which has been shown to reduce HbA1c levels. The Low-Carbohydrate Diet also helps lower blood pressure, increase HDL, lower triglyceride levels, and assists in weight loss.[18] Our program encouraged PCPs to provide diet/nutrition education to patients with Type 1 or Type 2 diabetes whose HbA1c was ≥8%. As this course was offered to PCPs who work in the primary care setting, this program did not discuss the diet/nutrition needs related to gestational diabetes. This analysis evaluated change in knowledge, attitude, and clinical practice after PCPs engaged in a CME program.

Methods

Study Setting

A quality improvement (QI) project utilizing a pretest-posttest design was conducted at a CHC in Massachusetts in September 2023. A 50-min virtual CME program entitled "Diet & Nutrition Therapy for Patients with Diabetes" was offered to all medical providers from the CHC. The CME course was developed internally and provided by the project lead, who is a practicing Primary Care Nurse Practitioner and an RDN, having extensive knowledge in medical nutrition

therapy for chronic illnesses (or diseases). The population targeted for this intervention were internal or family medicine doctors/doctors of osteopathic medicine (MD/DO), nurse practitioners and physician assistants (collectively known as APP), who serve as PCPs. Participants were recruited by having the CME program during a dedicated one-hour medical department provider meeting, where attendance is expected. The primary focus of the program was to deliver the current standards of care guidelines and recommendations related to diet/nutrition and diabetes management. Utilizing 2023 ADA standards of care guidelines/recommendations[2], evidence-based practice research[18], and education material from the Academy of Nutrition and Dietetics[19], the following four main learning objectives were developed:

1) Epidemiology/prevalence of diabetes;
2) Complications associated with uncontrolled diabetes;
3) Discuss goals of diet/nutrition therapy for patients living with diabetes;
4) Review evidence-based practice standards of care and guidelines/recommendations regarding diet/nutrition and diabetes.

The curriculum was designed using the 4A (*anchor, add, apply, away*) learning task model.[20] This model was chosen because it is interactive and geared to adult learners. Participants who attended the live session were awarded one *AMA PRA Category 1 Credit*^{TM}, which was accredited by the *American Academy of Family Physicians* (see Supplementary Appendix 1).

Data Collection and Analysis

Prior to the CME program, participants were surveyed regarding background characteristics, including provider type, years in practice, and gender, as well as their nutrition counseling knowledge and attitude about nutrition counseling. A web-based software application for electronic collection and management of research and clinic data, Research Electronic Data Capture (REDCap©), was used for its ease of survey distribution, data collection, and analysis. Participants accessed the CME program via Zoom© during a dedicated medical department provider meeting. A program evaluation survey was distributed immediately after the CME intervention and was accessible for one week. Two weeks after the intervention, PCPs completed the post survey assessing their nutrition counseling knowledge and attitude about nutrition counseling. Lastly, a chart review was completed utilizing the CHCs electronic medical record (EMR), which evaluated documentation of counseling practices by PCPs.

Knowledge and Attitude

Knowledge of diet/nutrition and diabetes was assessed using an internally developed 10-item assessment tool, the Nutrition Management of Diabetes Assessment (NMDA) (see Supplementary Appendix 2). The NMDA was constructed from Recommendations 5.10 to 5.17 found in Table 5.1 of the ADA 2023 Standards of Care for Medical Nutrition Therapy Recommendations, as well as educational material from the Academy of Nutrition and Dietetics.[2,19] All questions were reviewed for their relevance and understandability by 13 Certified Diabetes Educators (CDEs) and RDNs from Massachusetts General Hospital in Boston, MA.

Attitude about nutrition in patient care was evaluated using a validated self-reported tool,the Nutrition in Patient Care Survey (NIPS). Utilizing a 5-point Likert scale, the NIPS is a 45-item survey that contains five subscales. The NIPS instrument demonstrates content and structural validity with factor analysis revealing a Kaiser–Meyer–Olkin index of 0.78 for the five dimensions. The subscale intercorrelation are low (median = 0.07), therefore subscales data are independent.[21] It has also demonstrated reliability evidence with the subscale's alpha coefficients ranging from 0.67 to 0.82, indicating internal consistency reliability. To reduce the total number of questions for the pre and post survey as to maximize participants response rate, PCPs completed two sections of the NIPS: "Nutrition in routine care" (8 items) and "Physician efficacy" (6 items).

Counseling Practices and Referrals

Chart audits from the CHC were conducted to assess counseling and/or referral practices among patients with an HbA1c ≥8% who had an office visit to a PCP between August 1 and October 20, 2023. Exclusion criteria included patients under 18 years old, unfinished documentation at the time of audit, and the charts of the project lead. To assess diet/nutrition

counseling frequency, the Assessment & Plan portion of the note, where diabetes was addressed, was analyzed. Visits were scored as having included counseling if the pre-populated Smart Phrases that were written and distributed as part of the project were documented or documentation of a counseling word, or conjugate, along with a nutrition word, or conjugate as noted in Table 1. Visits that included counseling on topics other than nutrition were not scored positive.

Referrals for nutrition counseling to an outside healthcare facility were also measured, because the CHC did not have a RDN on staff. Visits were scored as having included referral if the Assessment & Plan portion of the note mentioned that the patient has been referred to or is being managed by a dietitian/nutritionist or referred to another provider or facility (eg endocrinologist) with the specific intent of receiving diet/nutrition counseling. In other words, the provider combined a referral word or conjugate, along with a nutrition word or conjugate, as listed in Table 1. Visits that included referral on topics other than nutrition were not scored positive. Four weeks prior and six weeks after the CME program, the frequency in which diet/nutrition counseling or referral was evaluated.

Statistical Analysis Plan

A two-sample independent *t*-test compared the NMDA and NIPS group means pre and post intervention and Cronbach's alpha was used to assess the internal consistency reliability. Chi-Square was used to assess change in the proportion of respondents correctly answering individual NMDA questions. Additionally, the point biserial (PBS) for each question was calculated by correlating the correct vs incorrect response to the overall score on the remaining nine items of the NMDA. To assess the impact of the intervention on counseling and referral rates, chi-square was used to test the pre-post change and Kendall's tau was used to test the trend. Statistical significance was set at $P < 0.05$.

Results

PCPs (N = 32) at a CHC in Massachusetts were eligible to participate in the intervention. Roughly, 91% of PCPs (n = 29) were in attendance for the live CME program. Four-fifths of PCPs (n = 23) completed the pre-survey assessment before the CME intervention. Roughly 66% of PCPs (n = 19) completed the post-survey assessment that was available to them two weeks after the CME program. Table 2 shows the characteristics of the study participants.

Knowledge and Attitude

The NMDA yielded acceptable internal consistency reliability, given Cronbach's alpha coefficient of 0.73. The CME intervention significantly improved knowledge by an average score of 36% ($P < 0.001$) (Figure 1). A score of 80% or better was targeted as a "passing" grade. While no PCPs achieved this score before the CME intervention, roughly 21% (n = 4) of PCPs accomplished this score in the post test. The 10 questions were analyzed separately at both pre and post

Table 1 Words Used to Determine the Presence or Absence of Counseling or Referral

Counseling Words	Referral Words	Nutrition Words
Talk	Refer	Diet
Discuss	Sent	Nutrition
Counsel	See	Food
Educate	Manage	Calories
Advise	Continue	Carbohydrates
Review		Fat
		Protein
		Fiber
		Sugar

Table 2 Baseline Characteristics of PCP (n = 23)

Type of PCP:	**n (%)**
Internal Medicine	10 (44)
Family Medicine	7 (30)
Medical Specialist, however also serve as PCP	3 (13)
Primary Care Nurse Practitioner/Physician Assistant	3 (13)
Years in Practice:	
0–10	13 (56)
11–20	5 (22)
21+	5 (22)
Gender:	
Male	13 (57)
Female	9 (39)
Transgender/Non-Binary	1 (4)

Abbreviation: PCP, Primary Care Provider.

CME intervention. There was a significant gain of knowledge ($P < 0.05$) in seven of the ten questions. Furthermore, eight questions showed PBS scores ranging between 0.24 and 0.64 (Table 3).

In terms of attitude, there was no statistically significant difference between mean scores of the pre and post survey results in *Nutrition in patient care* of the NIPS. This subscale had acceptable internal consistency reliability, given an

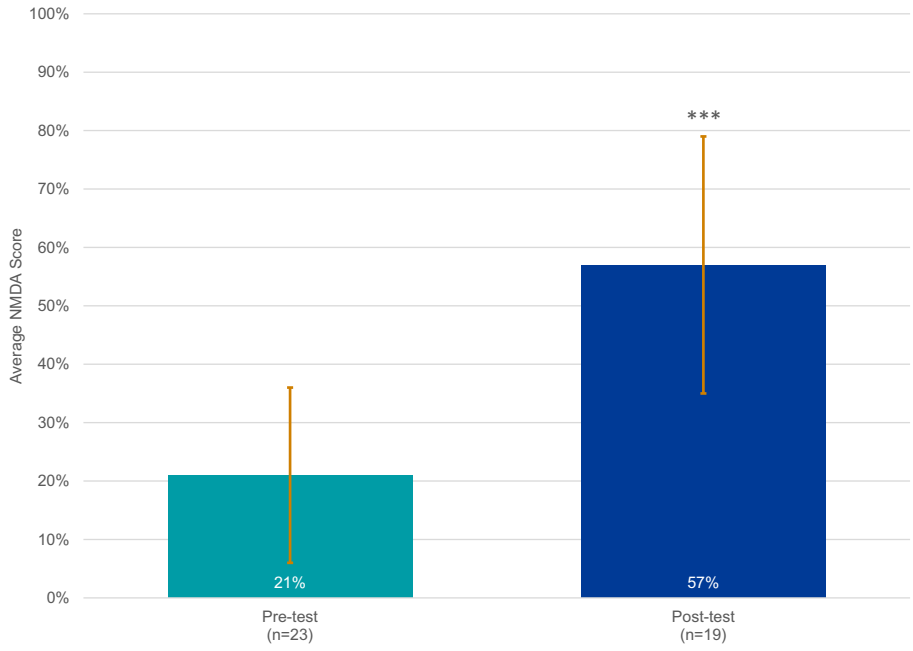

Figure 1 Change in NMDA Score. Pre-test versus post-test NMDA score after a continuing medical education program. Bar height indicates mean score and error bars indicate standard deviation. Significance indicated as ***=p<0.001.
Abbreviation: NMDA, Nutrition Management of Diabetes Assessment.

Table 3 NMDA Score per Question (% Correct)

Question	Pre-test Correct Answer (%)	Post-test Correct Answer (%)	Diff (%)	P-value	PBS
Q1: Diet/Meal Plan that does not reduce HbA1c	22	74	52	0.001	−0.11
Q2: Goals of nutrition therapy	13	26	13	0.276	−0.13
Q3: Percent weight loss to achieve improved glycemic control	35	68	33	0.030	0.37
Q4: One "CHO choice" is how many grams	13	68	55	0.000	0.64
Q5: Grams of CHO in one slice medium bread	22	74	52	0.001	0.24
Q6: Grams of CHO in ONE cup of cooked rice	10	50	40	0.005	0.53
Q7: Grams of CHO in ONE cup of juice	22	42	20	0.155	0.42
Q8: Meal with most grams of CHO	04	16	12	0.209	0.31
Q9: Daily fiber recommendations	23	74	51	0.001	0.44
Q10: Type of insoluble fiber	52	84	32	0.028	0.50

Abbreviations: CHO, Carbohydrates; NMDA, Nutrition Management of Diabetes Assessment; PBS, Point Biserial correlation coefficient (Discrimination Index).

alpha coefficient of 0.777. There was a difference between mean scores of the pre and post-survey results ($P < 0.01$) in *Physician efficacy* of the NIPS (Figure 2). This subscale had good internal consistency reliability, given an alpha coefficient of 0.896.

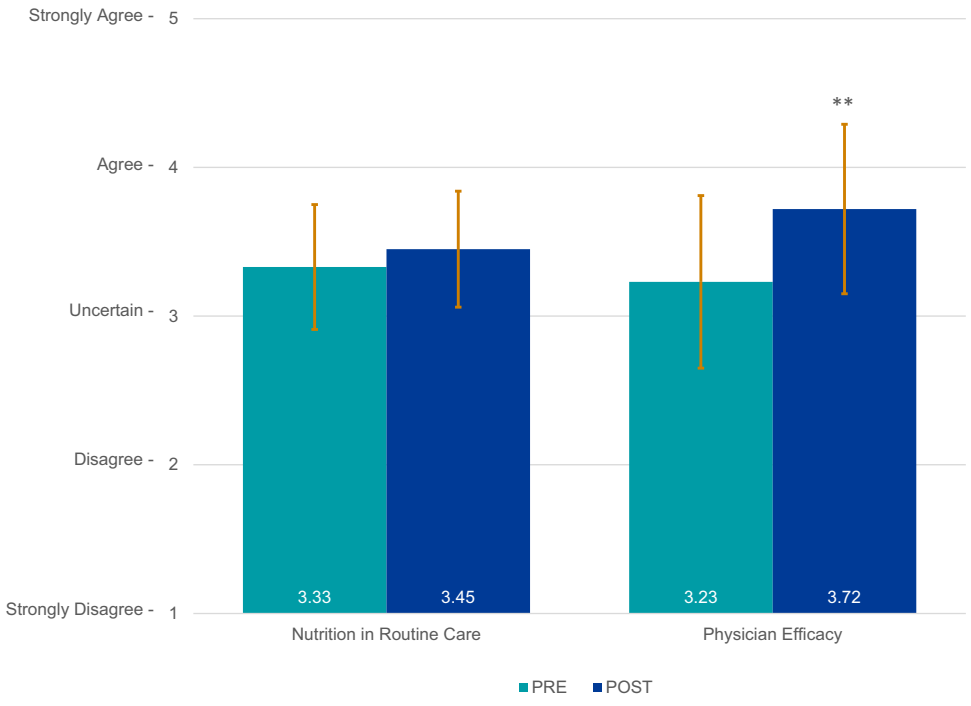

Figure 2 Change in NIPS Subscales. Pre-test versus post-test NIPS sub-scales after a continuing medical education program. Bar height indicates mean score and error bars indicate standard deviation. Significance indicated as **=p<0.01.
Abbreviation: NIPS, Nutrition in Patient Care Survey.

Counseling and Referrals

Pre-intervention diet/nutrition counseling was provided by PCPs in roughly 16% (5 out of 31) of visits, and no referrals were placed. For the six weeks following the CME intervention, roughly 47% (27 out of 58) of visits addressed either diet/nutrition counseling or referral ($P < 0.05$). The six weeks post intervention showed a positive difference in the trend of diet/nutrition counseling ($P < 0.05$), while there was no significant difference in trend of just referrals ($P = 0.30$). When considering either diet/nutrition counseling or referral, there was a trend difference ($P < 0.05$) (Figure 3).

Program Evaluation

Roughly 76% of participants (n = 22) that were in attendance completed the program evaluation. While 82% rated the program as "excellent" and 18% rated it as "good", 95% endorsed they were likely/extremely likely to recommend this CME program to other PCPs.

Discussion

The quality of care delivered to patients living with diabetes is a significant challenge for healthcare systems in the USA[22] and across the world[23]. It is within the primary care setting that PCPs serve as a critical point in the management of chronic health conditions. In order to care for chronic health conditions, such as diabetes, PCPs need to stay up-to-date on guidelines, recommendations, and evidence-based practice. As a result of the COVID-19 pandemic, the delivery of online CME has proven to be effective, positively influencing healthcare professional's competency and performance in clinical practice.[24] Few studies have examined if online CME changes practice in the management of type 2 diabetes.[25] Similar to prior research,[9] this QI project demonstrated an improvement in knowledge following a CME program. Our work expands on previous literature by including an objective measure of practice, using a previously validated measure of attitude, and providing evidence on the development and reliability of our knowledge assessment.

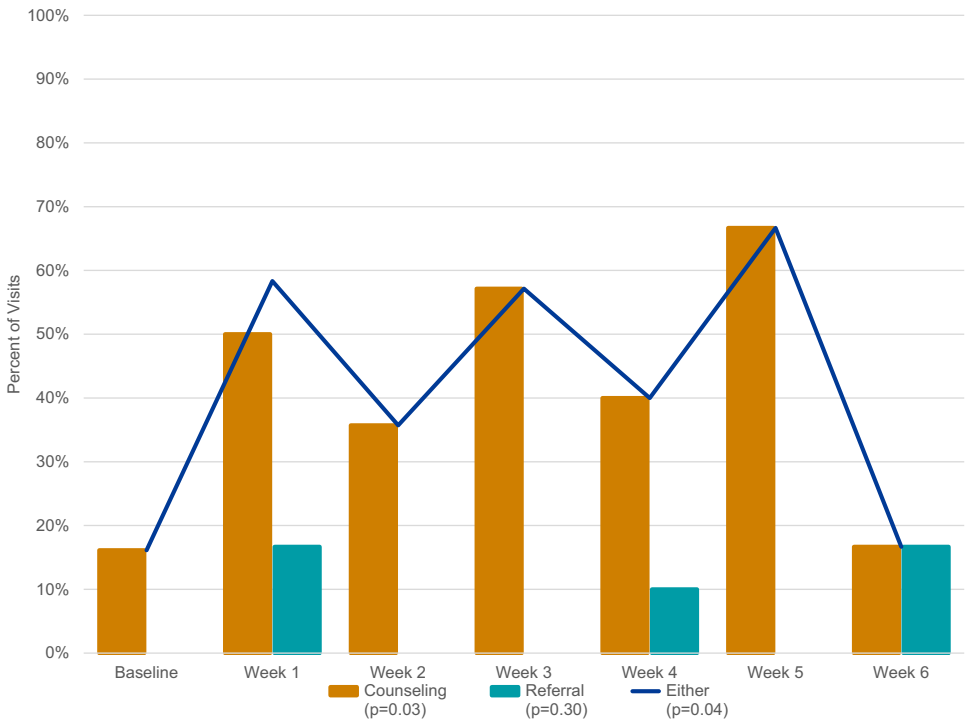

Figure 3 Trend in Diet/Nutrition Counseling, Referral, or Either (among visits with HbA1c ≥8%). Rates of counseling (Orange bar), referral (teal bar), or either (blue line) delivered to patients with uncontrolled diabetes among visits by primary care providers.
Abbreviation: HbA1c, glycosylated hemoglobin A1c.

Change in Knowledge

Our results are consistent with two studies that showed an online single session CME is an effective strategy to improve diet/nutrition knowledge in the management of diabetes amongst medical providers.[8,9] A large-scale study by Emami et al evaluated over 500 PCPs change in knowledge pre-post CME session that assessed knowledge on lifestyle modifications, which included *advice on healthy diet*. This study concluded there was a significant change difference in *advice on healthy diet* of about 28%.[8] Similarly, Hicks & Murano[9] evaluated 43 medical providers, 18 of which were either family medicine or internal medicine providers, who took part in pretest-posttest design that evaluated change in knowledge on diabetes diet/nutrition. The authors reported a statistically significant improvement in knowledge of about 30%.

Although the percent change is reasonably similar amongst the two studies and this study, it is important to be aware of the differences in baseline characteristics of population and knowledge-based assessments. Future studies should consider evaluating PCPs diabetes diet/nutrition knowledge utilizing the same knowledge-based assessment tool. The two studies and this study only involved a single CME program, not multi-modular. Future studies should consider using the same knowledge-based tool, however have a single vs multi-module CME session on diet/nutrition and diabetes.

Change in Attitude

One important finding related to PCPs attitude is the significant improvement in provider efficacy. Approximately, 90% of PCPs acknowledged that their patient-education efforts would be effective in increasing patient compliance. This study offered several tools and resources, which likely contributed to the increase in provider efficacy. An interactive online CME program developed and led by an expert in the field, who is also a colleague to the participants, may have caused an improvement in efficacy. Furthermore, to help guide their education and counseling practices, PCPs were provided an educational handout that could be given to patients. Additionally, Smart Phrases were developed in the EMR which could be utilized for providing education and to aid in office visit documentation.

The findings in our study are consistent with a pretest–posttest study that utilized the NIPS to evaluate the attitude of third year medical residents before and after completing novel curricular activity discussing nutrition.[26] Unlike our intervention that utilized a single CME program, Ramsetty et al[26] used case-based modules. Despite these differences, Ramsetty et al and our study found statistically significant differences in *physician efficacy* at 5% and 15%, respectively. By contrast, the *Nutrition in patient care* subscale was found not to be statistically significant. Similarly, Ramsetty et al and our study found no significant change difference in *Nutrition in patient care* at 1% and 4%, respectively. The attitude of PCPs may not have changed in this subscale since the education session provided was geared largely to improving knowledge and ability to provide appropriate education and counseling. The *Nutrition in patient care* subscale reflects attitude about the value of counseling in primary care.

Change in Clinical Practice

While the results are similar to prior literature in the change in attitude and knowledge, this project builds upon that literature by demonstrating an improvement in clinical practice after receiving an educational intervention. Similar to this study, Lee et al[10] utilized a pre-post design that evaluated change in performance of PCPs counseling practices after viewing a CME session. In their study, there was a significant change difference of about 23% in counseling practice after an online CME, while our study showed a 30% change difference. Lee et al also recorded a 1.15 percentage point change in HbA1c levels at follow-up from baseline, suggesting that our study has the potential for clinically significant findings.[10] Furthermore, as a result of increased lifestyle counseling and improved HbA1c levels, there are fewer CV events or deaths amongst patients living with diabetes.[3]

Due to the short nature of this study, future studies should evaluate if primary care-based diabetes diet/nutrition counseling alone can reduce HbA1c level. In order to ensure that practice change continues, efforts can be made for sustainability. PCPs should seek diabetes education courses that focus not only on pharmacological therapy but non-pharmacological therapy like diet/nutrition. Additionally, education material and handouts can be printed and placed in exam rooms for PCPs use with their patients.

Limitations

This study has several limitations. One limitation was the small sample size and that participants were from one CHC in Massachusetts. Given this context, our study may not be generalizable to all PCPs at CHC across the USA or the world. A second limitation was that CME intervention was a single program, in which nutrition concepts were discussed with the hopes that PCPs would integrate the knowledge gained into their counseling practices. The CME program primarily reviewed carbohydrate counting in the context of the Low Carbohydrate Diet. We could have included additional sessions reviewing additional meal plans (eg Mediterranean Diet), case studies, and ways to incorporate motivational interviewing, which could have enhanced counseling practices amongst PCPs. A third limitation was that we utilized self-reported surveys. This study could potentially have biases in how participants respond. For example, participants may have thought they were knowledgeable about diabetes diet/nutrition, while the NMDA scores revealed they were suboptimal. A fourth limitation of the study was not being able to assess the degree of counseling practices. Our assessment of counseling frequency relied on documentation, as we were not able to analyze how much time was spent nor capture in detail the content taught during office visits.

Conclusion

This project appears to be the first to evaluate the change in knowledge, attitude, and counseling practices amongst PCPs after completing a single online CME program focused on diet/nutrition management of diabetes in the primary care setting of a CHC. PCPs improved their knowledge and efficacy, which likely contributed to improved counseling practices. Providing PCPs with CME on up-to-date and evidence-based practice diet/nutrition guidelines and recommendations can lead to improved counseling practices, which in turn may improve the health and well-being of patients. Due to the short nature of this project, future studies should examine clinic outcomes by following HbA1c levels of patients for 3–6 months after PCPs have received diet/nutrition education and provided counseling.

Ethical Approval

This quality improvement (QI) project was deemed non-human subject research (NHSR) by the Mass General Brigham Institutional Review Board, and therefore did not require IRB approval.

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Disclosure

The author(s) report no conflicts of interest in this work.

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