

Original Article

Assessment of Students' Perception of the Nutrition Curriculum in a Canadian Undergraduate Medical Education Program

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Abstract

Background: Nutrition plays an important role in diseases, and physicians need to be proficient in providing nutrition counselling to patients. There is limited information regarding nutrition education in Canadian medical schools.

Objective: The objective of this study was to investigate students' perspectives about nutrition training provided in the undergraduate medical education program at Dalhousie University.

Methods: All medical students in their second, third, and fourth years of training at Dalhousie University were surveyed online with a 23-item questionnaire that included 10 nutrition competencies.

Results: Of 342 students, 89 (26%) completed the survey. Using a five-point Likert scale, ranging from one, indicating 'very dissatisfied/strongly disagree' to five, indicating 'very satisfied/strongly agree,' the mean overall satisfaction with nutrition curriculum was 2.9 ± 0.81 . Perceived competency in nutrition assessment had the highest mean satisfaction rating (3.98 ± 0.89). There was more variance on perceived competency, with other aspects of training including basic nutrition principles (3.51 ± 0.92), disease prevention (3.14 ± 1.12), disease management (3.48 ± 1.00), role of dietitians (2.97 ± 1.05), credible nutrition sources (3.14 ± 1.09), dietary assessment (2.82 ± 1.11), lifecycle nutrition (2.67 ± 1.09), food security (2.4 ± 0.95) and malnutrition (2.74 ± 0.93). Med-4 students agreed significantly more than Med-2 students regarding confidence about their understanding of the role of dietitians. Students recommended a longitudinal nutrition program, inclusion of dietitians as educators, and provision of evidence-based resources in the curriculum. The majority (79%) agreed that more nutrition instruction is needed. Satisfaction with nutrition education has not improved since 2010, despite curricular changes.

Conclusions: Medical students' satisfaction with nutrition education remains problematic. They want more nutrition training. Ongoing assessment and student feedback is important to make changes and improvements in the nutrition curriculum.

Keywords: Curriculum, Nutrition, Undergraduate medical education

Nutrition encompasses all disciplines of medicine, and its importance in disease prevention and management is well recognized. Poor dietary habits are strongly linked with ischemic heart disease, diabetes and cancer. The public perceives physicians to be a trusted source of nutrition information (1).

Therefore, adequate physician training in nutrition is important to improve individual and population health outcomes.

Studies have shown limitations in medical students' and physicians' knowledge and self-perceived competencies in the identification of dietary sources of macro- and micronutrients,

obesity, nutrition requirements across the lifecycle, malnutrition, identification of credible sources of nutrition information, dietary management of diabetes, cardiovascular disorders, and renal disease (2–8). Medical students and physicians in various countries report lack of satisfaction with the nutrition curriculum provided in medical schools and feel inadequately trained in nutrition counselling (5–7, 9–13). Medical students and residents believe that nutrition is important and that it is their responsibility to discuss nutrition with patients (3, 5, 8, 14).

Nutrition competencies and resources have been developed in various countries to support medical schools with nutrition curriculum. In 1985, the Food and Nutrition Board of the National Research Council published core nutrition competencies for medical schools and suggested dedicating at least 25 to 30 hours to nutrition education during training (15). In 2009, Canadian medical students reported an average nutrition instruction of 5.8 hours per month throughout their medical education program, which included nutrition-related material provided in separate nutrition courses and combined in physiology, pathology, endocrinology and gastroenterology courses. Dalhousie medical students reported an average of 4.6 hours per month of nutrition instruction (6). In 2002, the National Heart, Lung and Blood Institute and the National Institute of Diabetes and Digestive and Kidney Diseases developed the *Nutrition Curriculum Guide for Training Physicians*, which includes learning objectives for medical students, residents and physicians (16). There are similar nutrition curriculums developed by other countries (17–19).

In 2010, the Dalhousie Undergraduate Medical Education (UGME) program underwent a major revision of curriculum, and a nutrition component to a first-year course on Metabolism-1 was added. This was to enhance the nutrition competencies of students, partially in response to findings of a previous Canadian study (6). Previously, there was no formal nutrition curriculum in the UGME program.

OBJECTIVE

The purpose of this study was to investigate medical students' perceptions, attitudes and satisfaction with the nutrition curriculum offered in the undergraduate medical education program at Dalhousie University.

METHODS

The survey instrument included 23 questions categorized into demographics, perceptions regarding adequacy of nutrition instruction, attitudes, satisfaction, preferential teaching methods and recommendations for the UGME program. The design of questionnaire was adapted by permission from Gramlich et al. (6). The demographic section included

questions about campus location, year of study, nutrition background and nutrition-related electives. A five-point Likert scale (one = 'strongly disagree/dissatisfied', one = 'strongly agree/very satisfied') was used to assess agreement or satisfaction with adequacy of training, attitudes about nutrition, and satisfaction with nutrition curriculum. Students were also invited to provide comments for improving the nutrition curriculum. The survey was piloted on five medical students for clarity and feasibility.

All (n=342) medical students in their second, third and fourth year of training at Dalhousie University were invited by email to participate in the survey administered online using Opinio™ software. The first-year students were not included because they would not have received enough education to provide meaningful perspectives regarding nutrition curriculum. The study was conducted at the beginning of the second half of academic year. A reminder to all potential subjects was sent three weeks later. Complete anonymity of the participants was maintained with no coding or identifying information.

Statistical Analysis

Results were assembled in Opinio™ and exported into SPSS Statistics 23™ for analysis. Descriptive statistics were derived as frequencies, percentages, means and standard deviations. Analysis of Variance (ANOVA) was used to compare responses on both individual questions and summed scores between Med-2, Med-3, and Med-4 students, with a Bonferroni post hoc test to examine where specific differences were between groups. Due to differences in group size, homogeneity of variance was tested using the Levene test. Since a series of consecutive ANOVAs were run, a Bonferroni correction to the P value was applied, and a cut-off of $P \leq 0.003$ was used for statistical significance. One-way analysis of variance using summed scores on the five questions around attitudes about nutrition and the 10 questions on perceived confidence in nutrition competencies were completed. These questions were summed in order to provide a more global assessment of attitudes and confidence about nutrition.

The Pearson Chi-square test was used to compare results with those of original data from a study by Gramlich et al. (6). For the Chi-square analysis, our study responses were dichotomized into 'agree' (combined four and five rankings) and 'disagree' (combined one and two rankings). A response of three was considered neutral and was not included in analysis. In the study by Gramlich et al., responses to questions were on a 10-point Likert scale. Therefore, these responses were dichotomized into 'agree' (responses [7–10]) and 'disagree' (1–4). Responses ranked five or six were considered Neutral and were not included in the analysis. Statistical significance was set at $P < 0.05$ for this analysis.

Open-ended comments were categorized into themes using thematic analysis (20).

Ethics Approval

The study proposal was submitted to the Research Ethics Board of Dalhousie University. They ruled that the research constituted programme evaluation with minimal risk to the participants and did not require formal approval under Tri-Council Policy Statement (TCPS) section 2.5.

RESULTS

Of the 342 medical students invited to participate, 89 (26%) fully completed the survey. An additional three students only completed the demographics and questions on perceived adequacy of training, and these responses are included in that component of the analysis. The characteristics of the survey respondents are shown in [Table 1](#). Dalhousie medical school has the main campus in Halifax, Nova Scotia, with a distributed site in Saint John, New Brunswick. In total, there were 79 (85.8%) participants from the Halifax campus and 13 (14.2%) from Saint John. Of the respondents, 63% were in Med 2, 15.2% in Med 3 and 21.7% in Med 4.

Perceptions Regarding Adequacy of Training in Various Nutrition Competencies

[Figure 1](#) shows responses by all participants regarding confidence in various nutrition competencies. The mean student (n=92) ratings regarding adequacy of nutrition training in various competencies are shown in [Figure 2](#). Nutrition assessment had the highest percentage of students agreeing or strongly agreeing to having confidence in this domain (81.5%) and had the highest mean ranking using the five-point Likert scale (3.98 ± 0.89). This was followed by basic nutrition knowledge (61%, 3.51 ± 0.92) and role of nutrition in disease management (61%, 3.48 ± 1.00). The categories with the lowest confidence

were strategies to address food security (15.2% , 2.4 ± 0.95), nutrient requirements across the lifecycle (17.3% , 2.67 ± 1.09), malnutrition (22.8% , 2.74 ± 0.93) and assessment of dietary intake (25% , 2.82 ± 1.11).

There was a significant difference in the responses between Med-2, Med-3 and Med-4 students regarding understanding the 'role of registered dietitian', where Med-4 students (3.60 ± 0.99) felt significantly ($P=0.002$) more confident than Med-2 students (2.71 ± 1.01), yet there was no significant difference between Med-3 students (3.14 ± 0.95) compared with Med-2 or Med-4 students ($P \geq 0.30$). Although there were no other statistically significant differences among the groups, there was a trend of lower mean rankings in perceived nutrition competencies amongst Med-3 students as compared with Med-2 and Med-4 students.

Summed scores showed a trend in the differences between Med-2 (30.55 ± 4.96), Med-3 (28.78 ± 6.25) and Med-4 (33.20 ± 6.41) students on perceptions around training ($P=0.06$), where Med-3 students tended to have lower scores than Med-2 or Med-4 students, although this was not statistically significant unless where indicated on the individual questions reported previously.

Attitudes Regarding Nutrition

Student responses (n=89) regarding nutrition attitudes are shown in [Table 2](#). All students agreed or strongly agreed that nutrition is important in both the prevention and management of disease; 97.8% agreed or strongly agreed that physicians should be involved in initiatives that promote healthy eating and physical activity; and 96.6% agreed or strongly agreed that physicians should be positive role models for nutrition and physical activity. When asked if more nutrition instruction should be provided, 78.6% agreed or strongly agreed. There were no significant differences in responses between Med-2, Med-3 and Med-4 students in any of the attitudes of nutrition studied ($P>0.05$). There was also no significant difference in summed attitude score across Med-2 (23.48 ± 1.97), Med-3 (24.08 ± 1.26) and Med-4 (22.6 ± 2.16) students ($P=0.08$).

Satisfaction with Nutrition Curriculum

The mean response on the overall satisfaction scale was 2.9 (± 0.81). About one-third (30.3%) of students indicated they were dissatisfied (n=24) or strongly dissatisfied (n=3) with the nutrition curriculum, whereas 47% had a neutral response. The mean satisfaction with the nutrition curriculum was not significantly different across Med-2 (2.88 ± 0.72), Med-3 (2.46 ± 0.98) and Med-4 (3.25 ± 0.85) students ($P=0.24$).

Comparison to a Previous Study on Nutrition Curriculum in Canadian Medical Schools

Students in our study were significantly more likely to agree that they received sufficient training in basic nutrition principles (75.7%

Table 1. Characteristics of study participants (n=92)

Student characteristics	Number of respondents	Total number of students (Med 2,3,4)
Dalhousie University campus:		
Halifax, Nova Scotia	79	254
St. John, New Brunswick	13	88
Year of study		
Med 2	58	110
Med 3 traditional clerkship	12	124
Med 3 longitudinal clerkship	2	12
Med 4	20	108
Background in nutrition and dietetics	2 (2.2%)	
Completed a nutrition-related Elective	9 (9.8%)	

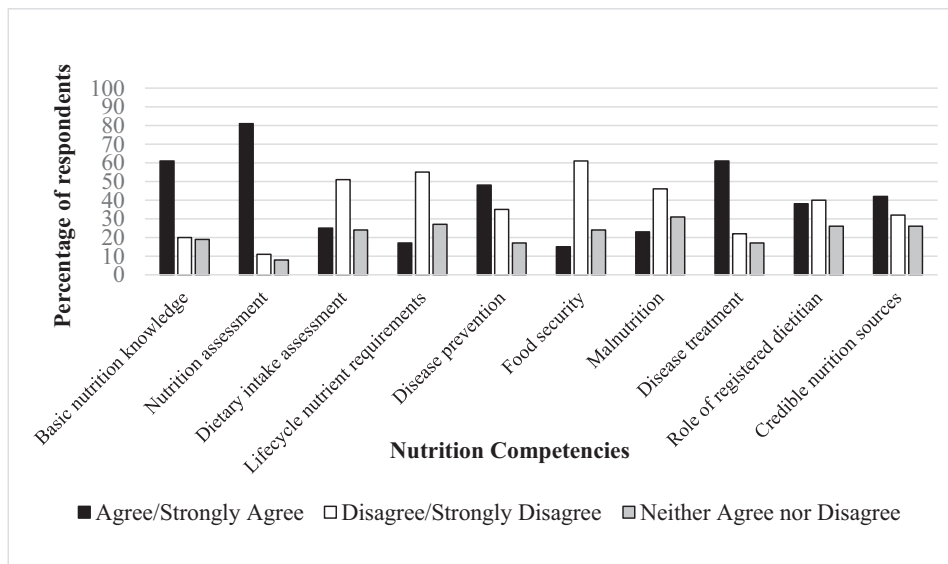


Figure 1. Cumulative perceived confidence in nutrition competencies by medical students.

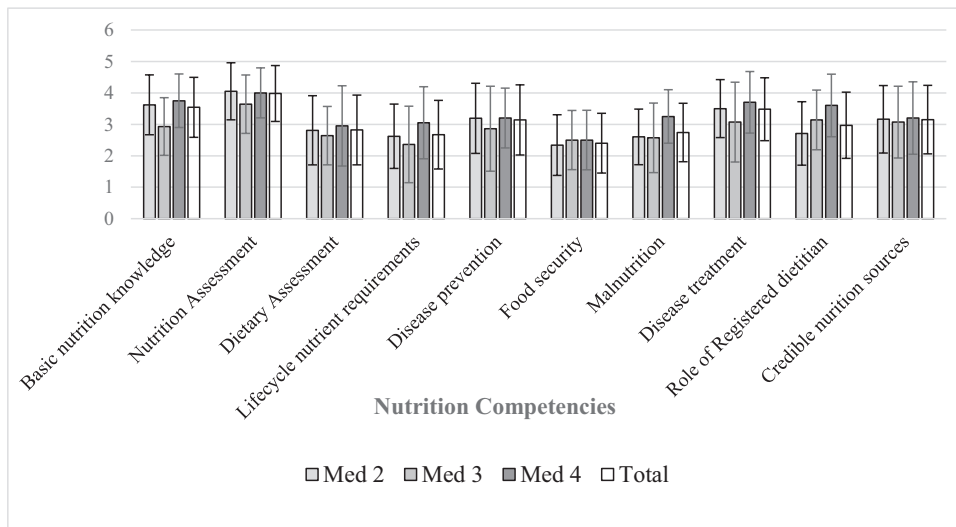


Figure 2. Mean responses on perceived confidence in nutrition competencies amongst medical students. (five-point Likert scale, one = strongly disagree; five = strongly agree).

versus 56.8%, $P=0.013$) and nutrition and disease management (73.7% versus 42.8%, $P < 0.001$). Compared with the study in 2012 (6), there were no significant differences in agreement with sufficiency of training in lifecycle nutrient requirement, nutrition and disease prevention and credible sources of nutrition information. There were also no significant differences in the percentage of students who believe more nutrition education should be provided during medical school (92.1% and 94.2%, $P=0.156$) or in the percentage of students who are dissatisfied with the nutrition curriculum offered at medical school (95.7% and 87.2%, $P=0.115$).

Preferred Teaching Methods and Recommendations for the Nutrition Curriculum

The most preferred teaching method indicated by students was experiential learning in clinical settings (71.9%), followed

by lectures in the classroom (61.8%), interdisciplinary setting (55%), case-based learning (54.0%) and online modules (36%).

The major themes from students’ comments regarding recommendations to enhance the nutrition curriculum are listed in Table 3. Students also commented to include a grocery store tour by a dietitian so they could learn more about reading food labels, making nutrition education part of interdisciplinary clinics that include dietitians and a ‘lifestyle lab’ to provide teaching about the role of nutrition in disease.

Students recommended a longitudinal nutrition program that includes some nutrition content in each course offered during the four-year program. Each course should provide evidence-based and practical information on the role of nutrition in disease prevention and management and should include sessions on nutrition support and nutrient requirements across the lifecycle in clinical years of the program. Nutrition should also be formally

Table 2. Attitudes regarding nutrition amongst medical students (five-point Likert scale, one = strongly disagree; five = strongly agree)

Year of Study	Nutrition is important in chronic disease prevention	Nutrition is important in chronic disease management	Physicians should be involved in healthy eating and physical activity initiatives	Physicians should be role models for healthy eating and physical activity	University should provide more nutrition instruction
Med 2	4.82 (± 0.39)	4.86 (± 0.35)	4.80 (± 0.52)	4.68 (± 0.61)	4.32 (± 0.77)
Med 3	4.92 (± 0.28)	4.92 (± 0.28)	4.92 (± 0.28)	4.92 (± 0.28)	4.38 (± 1.04)
Med 4	4.80 (± 0.41)	4.70 (± 0.47)	4.55 (± 0.61)	4.50 (± 0.61)	3.90 (± 0.97)
Total	4.83 (± 0.38)	4.83 (± 0.28)	4.76 (± 0.52)	4.67 (± 0.58)	4.24 (± 0.87)

Table 3. Themes from responses provided by medical students regarding recommendations to enhance the nutrition curriculum

- (1). Develop a longitudinal nutrition program
- (2). Have dietitians/nutrition experts as educators of nutrition curriculum
- (3). Include nutrition in skilled clinician program
- (4). Provide evidence-based nutrition resources
- (5). Provide a healthy food culture for medical students at the university campus

assessed in examinations such as multiple-choice questions and objective structured clinical examinations (OSCE).

Students recommended that dietitians or nutrition experts teach nutrition-related topics and attend relevant tutorial sessions. They suggested working with dietetic interns and dietitians more regularly during clinical training. Furthermore, clinical application of nutrition should be incorporated into the skilled clinician programs and should include nutrition assessment and malnutrition screening, diet history taking and assessment of food intake, malnutrition screening, and counselling skills. They also suggested having evidence-based nutrition resources on the online student portal. Some students stated that more effort should be directed toward ensuring that healthy food is provided at UGME program activities or medical student-led events such as Dalhousie Medical Student Society events. They want sessions on personal healthy eating practices such as how to eat well during medical school, how to shop on a budget and how to make healthy recipes.

Discussion

Nutrition is an important component of medical education. However, there is limited research on this subject in Canada. A study from 1984 found that all Canadian medical schools provided some nutrition education (21). In 2010, Gramlich et al. reported the majority of medical students were dissatisfied with the nutrition education they received at Canadian schools (6). They indicated receiving adequate training in basic nutrition

principles and health promotion but not sufficient training in the nutritional management of diseases, nutrient requirements across the lifecycle or the ability to identify credible sources of nutrition information. They agreed that more time should be dedicated to nutrition training during medical school. In 2016, 22.2% of graduating Canadian medical students disagreed or strongly disagreed that the nutrition instruction provided by the UGME program prepared them for required clinical learning experiences (22). Canadian physicians and medical residents also show lack of knowledge and dissatisfaction with nutrition training received during medical school (23, 24).

Our study found that medical students believe in the importance of nutrition. They are generally not satisfied with the nutrition curriculum currently being provided and want more education. Students either disagree or are uncertain if they receive sufficient training regarding food security, credible sources of nutrition information, the role of registered dietitians, the role of nutrition in disease prevention and management, malnutrition, dietary intake assessment, basic nutrition knowledge and lifecycle nutrient requirements. Dalhousie medical students agree that they receive adequate training in some nutrition assessment skills. These findings are consistent with perspectives of medical students and physicians within Canada, United States, and Australia (4, 7, 9, 10, 15, 25–28). Given the low number of students with a background in nutrition or who have done electives in this area, it was difficult to determine if these students had different satisfaction levels or perceptions regarding the adequacy of training in nutrition.

In our study, fourth year students were significantly more likely to agree that they have confidence in their understanding of the role of the registered dietitian compared with second year students. There were no other significant differences regarding perspectives about adequacy of nutrition training, attitudes about nutrition, or satisfaction with the curriculum. In contrast, other studies have found that junior medical students believe more in the importance of nutrition compared with senior ones (27, 29, 30). In one study, fourth year medical students reported significantly more self-perceived competency in providing basic nutrition education (80.5%) compared

with first-, second- and third-year students (67.2%, 59.5% and 74.2%, respectively) (26). We did see a trend of third-year medical students ranking a lower confidence with many of the nutrition competencies. This may reflect their overall decreased confidence with many domains of competencies as they move from didactic, classroom-based learning to an experiential learning environment (31).

Students in this study preferred a variety of teaching methods for nutrition education including experiential learning in clinical settings, lectures, interdisciplinary settings, case-based learning, and online modules.

Overall, our findings indicate that the nutrition curriculum is not providing students with confidence in their nutrition knowledge and skills, which is consistent with perspectives of medical students in the United States and other countries. There has been little improvement in student perceptions regarding the nutrition curriculum since implementation of the nutrition course in 2010. Moreover, very few students participating in the study had a nutrition background. This is concerning given the role of nutrition in health and disease, the rising obesity rates, the high prevalence of malnutrition in hospitalized patients, increasing food insecurity rates in Nova Scotia and Canada, and the aging population (32–34).

In comparison to the study (6) in 2010, significantly more students in our study agreed that they received adequate training in the domains of basic nutrition principles and the role of nutrition in treatment of diseases. However, mean response for these domains was primarily neutral, and almost 50% did not agree that they received adequate training in these areas. In addition, there seems to have been no significant improvement in the students' satisfaction with the nutrition curriculum, with almost all wanting more nutrition education, a finding consistent with previous studies.

Important findings from this study are the recommendations provided by students for changes to the nutrition curriculum, which can be used as a guide to changes. These include incorporating nutrition education longitudinally in each course and during the practical training years (third and fourth year); formal assessment of nutrition competencies; ability to work with dietitians who should also teach the nutrition curriculum; practicing skills such as nutrition counselling, nutrition assessment and malnutrition screening in the skilled clinician program; providing access to evidence-based nutrition resources; and mandating a healthy food culture for medical students through types of food provided at student-events and the food venues present on campus. These recommendations are consistent with those previously published and are strategies used by other medical schools that have successfully implemented nutrition curriculum (11, 21, 23, 35–41).

Experiential learning is important. With respect to recommendations regarding healthy food culture, physicians are more

likely to counsel about healthy behaviours and have more confidence in doing so if they engage in such behaviours themselves. Therefore, creating a healthy food environment for medical students helps provide a holistic approach to nutrition education (41–43). Given that only 9% of students reported taking a nutrition-related elective, it would be helpful to expand such opportunities. Changes in students' confidence in nutrition knowledge and skills after curriculum enhancement should be studied.

This study has some limitations. The response rate of 26% is lower compared with studies surveying medical students and residents, which range from 38% to 50% (26, 27). Our sample had a disproportionately higher percentage of second-year medical students compared with other years, the cause being unclear. We speculate that the low response rate of third- and fourth-year students may be related to them being busy with their clinical rotations. Studies have shown that third- and fourth-year students have less belief in the importance of nutrition as compared with first- and second-year students (27, 29), which may skew our results. Therefore, one needs to be cautious in generalizing the findings to all medical students. The students who did not participate in this study may have had less interest in nutrition, creating a potential bias in the results.

Conclusions

Satisfaction with nutrition education remains problematic among medical students. They want more training in nutrition. Despite curricular changes, satisfaction with nutrition curriculum is suboptimal. Suggested strategies for improvement include a longitudinal nutrition program and inclusion of dietitians as expert educators. Ongoing systematic assessment of education received and feedback by students are important to guide changes and improvements in the nutrition curriculum.

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References

1. American Dietetic Association. American Dietetic Association nutrition and you: Trends 2011 survey. 2011. <http://www.eatrightpro.org/resource/media/press-releases/new-in-food-nutrition-and-health/ada-releases-findings-of-nutrition-and-you-trends-2011-survey> (Accessed October 2017).
2. Temple NJ. Survey of nutrition knowledge of Canadian physicians. *J Am Coll Phys* 1999;18:26–9.
3. Foster KY, Diehl NS, Shaw D, et al. Medical students' readiness to provide lifestyle counselling for overweight patients. *Eat Behav* 2002;3:1–13.

4. Makowske M, Feinman RD. Nutrition education: A questionnaire for assessment and teaching. *J Nutr* 2005;4. <https://nutritionj.biomedcentral.com/articles/10.1186/1475-2891-4-2> (Accessed December 2017).
5. Vetter ML, Herring SJ, Sood M, et al. What do resident physicians know about nutrition? An evaluation of attitudes, self-perceived proficiency and knowledge. *J Am Coll Nutr* 2008;27(2):287-98.
6. Gramlich LM, Olstad DL, Nasser R, et al. Medical students' perceptions of nutrition education in Canadian universities. *Appl Physiol Nutr Metab* 2010;35:336-43.
7. Kiraly LN, McClave SA, Neel D, et al. Physician nutrition education. *Nutr Clin Pract* 2014;29:332-7.
8. Hans SL, Auer R, Cornuz J, et al. Clinical nutrition in primary care: An evaluation of resident physicians' attitudes and self-perceived proficiency. *Clin Nutr ESPEN* 2016;15:69-74.
9. Mihalyuk TV, Scott CS, Coombs JB. Self-reported nutrition proficiency is positively correlated with the perceived quality of nutrition training of family physicians in Washington State. *Am J Clin Nutr* 2003;77:1330-6.
10. Crowley J, Ball L, Laur C, et al. Nutrition guidelines for undergraduate medical curricula: A six-country comparison. *Adv Med Educ Pract* 2015;6:127-33.
11. Gomathi KG, Shehnaaz SI, Khan N. Is more nutrition education needed in the undergraduate medical curriculum? Perceptions of medical graduates from a medical university in the United Emirates. *Sultan Qaboos Univ Med J* 2014;14:e551-5.
12. Morris NP. The neglect of nutrition in medical education: A firsthand look. *JAMA Intern Med* 2014;174:841-2.
13. Sodjinou R, Bosu WK, Fanou N, et al. Nutrition training in medical and other health professionals schools in West Africa: The need to improve current approaches and enhance training effectiveness. *Glob Health Action* 2014;7:24827. doi:10.3402/gha.v7.24827.
14. Schoendorfer N, Schafer J. Enabling valuation of nutrition integration into MBBS program. *J Biomed Educ* 2015;Article ID 760104, 6 pages. <http://dx.doi.org/10.1155/2015/760104> (Accessed December 2017).
15. Nutrition Research Council US Committee on Nutrition in Medical Education. Nutrition education in U.S. medical schools. Washington (DC): National Academies Press (US), 1985.
16. National Heart, Lung, and Blood Institute. Nutrition Curriculum Guide for Training Physicians. 2002. https://www.nhlbi.nih.gov/research/training/naa/products/curr_gde.pdf (Accessed August 2017).
17. Adams KM, Kohlmeier M, Powell M, et al. Nutrition in medicine: Nutrition education for medical students and residents. *Nutr Clin Pract* 2010;25(5):471-80.
18. Ball L, Crowley J, Laur C, et al. Nutrition in medical education: Reflections from an initiative at the University of Cambridge. *J Multidiscip Healthc* 2014;7:209-15.
19. Ray S, Laur C, Douglas P, et al. Nutrition education and leadership for improved clinical outcomes: Training and supporting junior doctors to run nutrition awareness weeks in three NHS hospitals across England. *BMC Med Educ* 2014;14:109.
20. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;3:77-101. https://www.researchgate.net/publication/235356393_Using_Thematic_Analysis_in_Psychology (Accessed December 2017).
21. Ng ML, Hargreaves JA. Status of nutrition education in Canadian dental and medical schools. *Can Med Assoc J* 1984;130(7):851-3.
22. Association of Faculties of Medicine of Canada (AFMC). Graduation Questionnaire National Report 2016. https://afmc.ca/sites/default/files/documents/en/Publications/2016_GQ_National_Report_en.pdf (Accessed October 2017).
23. Raman M, Violato C, Coderre S. How much do gastroenterology fellows know about nutrition? *J Clin Gastroenterol* 2009;43:559-64.
24. Singh H, Duerksen DR. Survey of clinical nutrition practices of Canadian gastroenterologists. *Can J Gastroenterol* 2006;20:527-30.
25. Adams KM, Lindell KC, Kohlmeier M, et al. Status of nutrition education in medical schools. *Am J Clin Nutr* 2006;83:941S-44S.
26. Connor R, Cialdella-Kam L, Harris SR. A survey of medical students' use of nutrition resources and perceived competency in providing basic nutrition education. *J Biomed Educ* 2015;Article ID 181502, 7 pages. <http://dx.doi.org/10.1155/2015/181502> (Accessed December 2017).
27. Morgan SL, Weinsier RL, Boker JR, et al. A comparison of nutrition knowledge of freshman and senior medical students: A collaborative study of southeastern medical schools. *J Am Coll Nutr* 1988;7:193-7.
28. Walsh CO, Ziniel SI, Delichatsios HK, et al. Nutrition attitudes and knowledge in medical students after completion of an integrated nutrition curriculum compared with a dedicated nutrition curriculum: A quasi-experimental study. *BMC Med Educ* 2011;11:58.
29. Spencer EH, Frank E, Elon LK, et al. Predictors of nutrition counseling behaviors and attitudes in US medical students. *Am J Clin Nutr* 2006;84:655-62.
30. Adams KM, Kohlmeier M, Zeisel SH. Nutrition education in US medical schools: latest update of a national survey. *Acad Med* 2010;85:1537-42.
31. O'Brien B, Cooke M, Irby DM. Perceptions and attributions of third year medical students struggles in clerkships: Do students and clerkship directors agree? *Acad Med* 2007;82:970-78.
32. Statistics Canada. Canadian Demographics at a Glance. Second Edition. 2011. <http://www.statcan.gc.ca/pub/91-003-x/91-003-x2014001-eng.pdf?contentType=application%2Fpdf> (Accessed October 2017).
33. Statistics Canada. Obesity. 2017. <http://www.statcan.gc.ca/eng/help/bb/info/obesity> (Accessed October 2017).
34. Tappenden KA, Quatrara B, Parkhurst ML, et al. Critical role of nutrition in improving quality of care: An interdisciplinary call to action to address adult hospital malnutrition. *JPEN* 2013;37(4):482-97.
35. Statistics Canada. Household Food Insecurity in Canada Statistics and Graphs. 2011-2012. <https://www.canada.ca/en/health-canada/services/nutrition-science-research/food-security/household-food-security-statistics-2011-2012.html> (Accessed October 2017).
36. Taren DL, Thomson CA, Koff NA, et al. Effect of an integrated nutrition curriculum on medical education, student clinical performance, and student perception of medical training. *Am J Clin Nutr* 2001;73:1107-12.
37. Schoettler CL, Lee JN, Ireland KA, et al. A novel method of increasing medical student nutrition awareness and education. *J Biomed Educ* 2015;Article ID 784042, 8 pages. <http://dx.doi.org/10.1155/2015/784042> (Accessed December 2017).
38. DiMaria-Ghalili RA, Edwards M, Friedman G, et al. Capacity building in nutrition science: Revisiting the curricula for medical professionals. *Ann NY Acad Sci* 2013;1306:21-40.
39. Lenders C, Gorman K, Milch H, et al. A novel nutrition medicine education model: The Boston University experience. *Adv Nutr* 2013;4:1-7.
40. Tobin B, Welch K, Dent M, et al. Longitudinal and horizontal integration of nutrition science into medical school curricula. *J Nutr* 2003;133:567S-72S.
41. Vickers KS, Kircher KJ, Smith MD, et al. Health behaviour counselling in primary care: Provider-reported rate and confidence. *Fam Med* 2007;39:730-5.
42. Frank E, Segura C, Shen H, et al. Predictors of Canadian physicians' prevention counseling practices. *Can J Pub Health* 2010;101:390-5.
43. Frank E, Carrera JS, Elon L, et al. Predictors of US medical students' prevention counseling practices. *Prev Med* 2007;44:76-81.