BMJ Open

Impact of nutrition education on nutritional knowledge and intentions towards nutritional counselling in Dutch medical students: an intervention study

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To cite: Coppoolse HL, Seidell JC, Dijkstra SC. Impact of nutrition education on nutritional knowledge and intentions towards nutritional counselling in Dutch medical students: an intervention study. *BMJ Open* 2020;**10**:e034377. doi:10.1136/bmjopen-2019-034377

► Prepublication history and additional material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2019-034377).

Received 25 September 2019
Revised 10 February 2020
Accepted 12 February 2020

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ABSTRACT

Objective Management of diet-related chronic diseases may benefit from improved nutrition education of medical students. This study aims to investigate the effects of a nutrition education course on nutritional knowledge and intentions towards nutritional counselling in Dutch medical students.

Design This is a pre–post intervention study with a comparison group. Participants completed self-reported questionnaires on nutritional knowledge and intentions towards nutritional counselling.

Participants In total, 118 medical students (64.4% undergraduate, 73.2% women) were recruited from two medical schools in the Netherlands (n=66 intervention group, n=52 comparison group).

Intervention The intervention group completed a 25-hour course in nutritional counselling (the Students Experienced in Lifestyle and Food (SELF) course) in addition to the standard medical curriculum. The comparison group followed the standard medical curriculum.

Outcome measures Self-reported nutritional knowledge and intentions towards nutritional counselling, including attitude, self-efficacy and social support.

Results Nutritional knowledge (B: 2.42, 95% CI 1.81 to 3.02), attitude in men (B: 0.50, 95% CI 0.13 to 0.87) and self-efficacy (B: 0.78, 95% CI 0.62 to 0.95) significantly increased in the intervention group compared with the comparison group. No significant differences were found for social support (B: 0.20, 95% CI −0.02 to 0.43) and attitude in women (B: 0.08, 95% CI −0.24 to 0.31) between the two groups.

Conclusions The SELF course increased medical students' nutritional knowledge and stimulated their intentions towards nutritional counselling. Future research is needed to evaluate the long-term impact of nutrition education interventions on physician practice patterns and patient outcomes.

Strengths and limitations of this study

- The nutrition education course was developed in cocreation with medical professionals and medical students to guarantee a broad and relevant medical nutrition education angle.
- The effects of the course were measured before and after the course among participating medical students and in the same period among medical students who did not participate.
- Randomisation would have been preferable but was difficult to organise in a group of students participating in a voluntary extracurricular course.
- Measurements were self-reported rather than assessed in performance-based clinical examinations or patient outcomes.

INTRODUCTION

Dietary interventions have proven to be successful in the prevention and management of important lifestyle-related diseases, such as type 2 diabetes and cardiovascular disease.[1 2] Nutritional counselling by physicians could help to improve diets in patients, especially since patients consider physicians to be one of the most credible sources of nutrition information.[3 4] However, the substantial body of evidence that supports the benefits of nutritional interventions by physicians has not yet been translated into medical training or practice.[5] As a consequence, physicians often lack the necessary knowledge, skills and confidence to counsel their patients effectively.[6] For example, a survey among cardiologists showed that 90% reported that they did not receive adequate nutrition education during fellowship, even though 95% believed that their role includes providing patients with at least basic nutrition information.[7]

Previous studies on the effects of medical nutrition education interventions have shown that educational interventions can improve medical students' competencies, physicians' practice behaviour and patients' health. A study in the UK indicated that a 2-day workshop for medical students could lay the foundation of nutritional knowledge and attitudes

relevant to clinical practice.[8] This very short 'one-off' course showed that it is possible to provoke relevant changes in nutritional care in medical students. However, the impact on physician practice patterns and on patient outcomes was not assessed. Results of a study on nutrition education for general practitioner (GP) trainees in the Netherlands showed that a computer-based instruction improved both GP trainees' nutritional knowledge and practice behaviour on the subject of nutrition.[9] Furthermore, a study in Brazil found that wasting and stunting in children were diminished after the implementation of an educational intervention on the provision of physician nutritional counselling to mothers and/or caregivers.[10]

Despite the opportunities and the demand from medical students to receive nutrition education, the status of nutrition education in the medical curriculum remains largely neglected. In the USA, the time devoted to nutrition during medical school is limited, with an average of 19 hours divided over 4 years.[5] This is not different from the Netherlands, where students receive an average of 29 hours of nutrition education over 6 years of study.[11] To respond to the need for greater nutrition education in medical schools' curricula in the Netherlands, the student-led 'Student and Nutrition Foundation' (SNF) was established in 2017.[12] They developed a nutrition education course named the SELF course (Students Experienced in Lifestyle and Food) to offer medical students additional nutrition education. This course provided us with the opportunity to investigate its effects on medical students. Therefore, the aim of this study was to investigate the effects of the SELF course on nutritional knowledge and intentions towards nutritional counselling of Dutch medical students. The results of this study provide insights into the effectiveness of nutrition education in medical students which can be used to improve current medical training and long-term medical care.

METHODS

Design

To investigate the effects of the SELF course, a pre–post intervention study with a comparison group was conducted. Data were collected via self-reported questionnaires using the online questionnaire service Qualtrics.[13] Data collection took place from April 2018 to June 2018.

Participants and recruitment

This study took place in two university teaching hospitals in Amsterdam in the Netherlands: the Amsterdam Medical Centre (AMC) and the VU University Medical Centre (VUmc). All medical students from the AMC and VUmc were eligible to participate in the study, but medical students who followed a newly developed nutrition course at the AMC simultaneously with the SELF Amsterdam course were excluded from the analyses.

Participants in the intervention group were recruited from 148 students who voluntarily enrolled in the SELF Amsterdam course in April 2018. All AMC and VUmc medical students of the 6-year medical curriculum could apply to this course and acceptance was based on a first-come-first-served basis. Participants in the intervention group were asked to complete the prequestionnaires and postquestionnaires in the lecture hall prior to the start of the first SELF Amsterdam lecture and after completion of the last lecture, respectively. The sampling frame for the comparison group consisted of all undergraduate and graduate medical students of the AMC and the VUmc who did not participate in the SELF Amsterdam course. Participants of the comparison group were approached before or at the end of the usual lecture times at the AMC and VUmc and by soliciting volunteers in the libraries of the two medical faculties. In the preintervention questionnaire, the comparison group was asked for their email addresses so that they could be approached for the postintervention measurement per email.

In total, 281 participants completed the preintervention questionnaire (n=115 intervention group, n=166 comparison group). A total of 15 students were excluded from the study sample for declining to sign the informed consent (n=1 intervention group, n=14 comparison group), and 23 students were excluded due to other reasons (n=15 intervention group, n=8 comparison group) (see figure 1 for a flow chart with details on the reasons for exclusion). After these exclusions, 243 medical students were eligible to participate (n=99 intervention group, n=144 comparison group). Ten weeks later, a total of 126 participants completed the postintervention questionnaire (n=74 intervention group, n=52 comparison group), of whom 8 participants were excluded due to missing preintervention measurement information (n=8 intervention group). The total study sample comprised 118 medical students (n=66 intervention group, n=52 comparison group) who completed both the preintervention and postintervention questionnaires.

Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting, or dissemination of our research.

Intervention

The SELF Amsterdam course was developed based on key themes represented in the literature, several brainstorm sessions with medical students and consultations with experts (September 2017–January 2018).[14] The course consisted of 25 contact hours divided over 10 consecutive weeks. Participants of the 10-week course had to contribute €10 (US$12) per person to cover administrative costs. The course was designed for up to 150 undergraduate and graduate medical students. The course covered a different topic related to nutrition and lifestyle in health and disease each week, for example nutrition and diabetes, nutrition and cancer, or nutrition and cardiovascular disease. In total, 25 subject experts were selected to host a lecture, based on the criteria for SELF educators (eg, having subject expertise and having

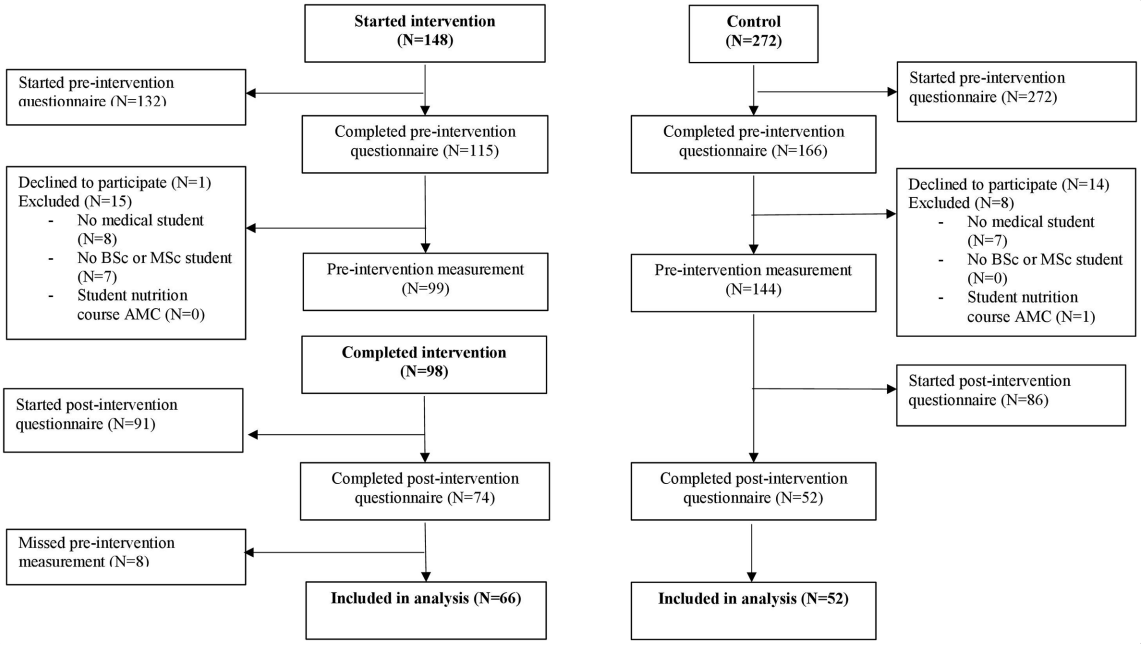

Figure 1 Flow chart of the study population. AMC, Amsterdam Medical Centre.

affinity with the goals of the SNF). The experts had various backgrounds, including but not limited to nutrition, psychology, dietetics and medicine.

Questionnaire development

A questionnaire to measure nutritional knowledge and intentions towards nutritional counselling was developed based on validated questionnaires, two expert meetings with health professionals and academics working in the field of nutrition, health and disease (n=12), and an online feedback session with five experts (see online supplementary file for the complete questionnaire used).[3 15–17] The framework for the two expert meetings was based on the Attitude–Social Support–Self-Efficacy (ASE) model by de Vries *et al*,[18] in combination with the topic list of the SELF Amsterdam course and existing questionnaires. The ASE model is a social cognition model that is commonly used in predicting and explaining health behaviours, including nutrition.[19] The model postulates that there is a reliable relationship between intentions and behaviour: if intentions increase, facilitated by knowledge, behaviour should change positively.[20]

During the expert meetings, experts discussed and wrote down specific scale items concerning knowledge, attitudes, social support and self-efficacy towards nutritional counselling which are essential for students to attain on completion of the SELF course. Experts were asked to provide input for potential questions on testing these scale items. The results of the two expert meetings were combined, and the outcomes were sent to a third group of experts to provide written feedback on accuracy and completeness. Next, three researchers (HC, JS and CD) critically revised the list of questions and created the final questionnaire. The questionnaire was pretested in a convenience sample of medical students (n=6) to assess understanding and comprehensibility. A few minor amendments were made and responses of these participants were excluded from the final analysis. The final questionnaire consisted of 49 questions. With forced answering options, participants were required to answer all questions before they could move to the next page of the questionnaire.

Outcomes

Nutritional knowledge was assessed with 13 multiple choice items (ie, 'What are the recommended daily amounts of fruits and vegetables for an adult woman (aged 19–50) according to the Dutch dietary recommendations?'). For all questions, one correct answer was possible, and 1 point per correct answer could be obtained. The total score ranged from 0 to 13 points, with higher scores indicating higher nutritional knowledge.

Intentions (attitude, social support and self-efficacy) were assessed by rating statements using 5-point Likert scales, from 'totally disagree (−2)' to 'totally agree (2)'. A mean value score (ranging from −2 to +2) was calculated, with a higher score indicating more positive intentions. Specifically, attitude was assessed with 10 items (ie, 'All physicians, regardless of specialty, should counsel high-risk patients about dietary change'). The internal consistency of attitude as checked with Cronbach's alpha was α=0.59 preintervention and α=0.87 postintervention. Social support was assessed with three items (ie, 'I know sufficient people in the medical faculty who I can contact in case I have questions on nutrition and lifestyle related topics') and had a Cronbach's alpha of α=0.53 preintervention and α=0.60 postintervention. Self-efficacy was assessed with nine items (ie, 'I am knowledgeable about nutrition education for a patient recently diagnosed with type 2 diabetes mellitus') and had a Cronbach's alpha

of α=0.75 preintervention and α=0.85 postintervention. Questionnaire items were randomised to prevent order effects and to minimise recall bias in the postintervention measurement.

Covariates

The questionnaire contained a demographics section with questions on potential confounding factors, including gender, medical faculty, training year, prior nutrition education, rating of the relevance of nutrition in future practice (5-point Likert scale) and rating of the benefit of more nutrition education in the medical curriculum (5-point Likert scale).[3 15–17] The variable 'Training year' was dichotomised into years 1–3 (BSc) versus years 4–6 (MSc). The variable 'Prior exposure to nutrition education' was dichotomised into students who indicated that they had completed either a course, practical or lecture on nutrition and lifestyle (yes) versus students who indicated that they had not received any previous nutrition education (no).

The postintervention questionnaire consisted of questions similar to the preintervention questionnaire. A question on SELF lecture attendance and on the appraisal of the SELF course on a scale from 1 to 10 were added to the postintervention questionnaire for the intervention group.

Data analysis

Continuous variables are presented as mean and SD, whereas categorical variables are presented as frequencies and percentages. Descriptive statistics, Pearson's χ^2 tests of contingencies and independent t-tests were used to assess potential differences in baseline characteristics of the participants who did not complete the postintervention questionnaire and those participants who completed both preintervention and postintervention questionnaires. Paired t-tests were used to assess the changes in outcome variables occurring between preintervention and postintervention measurements in the intervention and comparison group separately. For the paired t-tests, Cohen's d was calculated as a measure of effect size. To investigate the effects of the SELF course in the intervention group compared with the comparison group while controlling for other variables, linear regression analyses were performed on the four outcome variables separately. Intervention assignment was entered as independent variable, and preintervention scores of the dependent variables were added to each linear regression model to adjust for preintervention differences.

Variables obtained from preintervention data were tested for effect modification and confounding, respectively.[3 15–17] A statistically significant interaction term between the outcome variable and the potential effect modifier in the linear regression model was considered evidence of effect modification, resulting in further stratified analyses. A change in the estimated measure of association of 10% or more after including the potential confounding variable in the regression analysis was evidence of confounding. To adjust, confounding variables were simultaneously entered into the regression model.

All analyses were conducted using IBM SPSS V.24.0 software. The level for determining statistical significance was predefined as a p value of less than 0.05 for all comparisons.

RESULTS

The demographic characteristics of the participants who did not complete the postintervention questionnaire were similar to those of the participants with complete postintervention outcome information, except for their rating of the statement on the benefit of more nutrition education for medical students (data not shown). Participants who did not complete the postintervention questionnaire expected to have fewer benefits of more nutrition education in the medical curriculum than participants with complete postintervention outcome information (1.19 vs 1.37 points; p=0.03).

Among the included participants, three-quarters were female (73.2%) and two-thirds of the students had received previous nutrition education (65.3%), as can be seen in table 1. The number of participating MSc students in the comparison group (15.4%) was lower than in the intervention group (51.5%). Most students agreed with the statements that nutrition education was relevant in future practice (mean 1.42, SD: 0.60) and that more nutrition education would benefit students (mean 1.37, SD: 0.64). Students in the comparison group were statistically significantly more likely to indicate that they had received previous nutrition education compared with students in the intervention group.

Table 2 shows the results of the paired t-tests on the preintervention and postintervention measurements for change in nutritional knowledge scores and attitude scores, social support scores, and self-efficacy scores towards nutrition counselling in the intervention and comparison group separately. There was a statistically significant increase in the intervention group's scores from preintervention to postintervention in the parameters nutritional knowledge (M: 1.70, 95% CI 1.19 to 2.21), social support (M: 0.20, 95% CI 0.05 to 0.34) and self-efficacy (M: 0.84, 95% CI 0.71 to 0.98). Attitude scores did not change statistically significantly from preintervention to postintervention in the intervention group, nor did any of the outcome variables in the comparison group.

Table 3 shows the results of the linear regression analyses for the association between nutritional knowledge (0–13), social support (−2 to +2) and self-efficacy (−2 to +2) towards nutrition counselling and the SELF course. In the intervention group, nutritional knowledge scores statistically significantly increased with 2.42 points as compared with the comparison group (95% CI 1.81 to 3.02). There was no statistically significant difference in social support scores in the intervention group as compared with the comparison group. In the

Table 1 Characteristics of medical students included in the study in total and in the intervention and comparison group separately

	Total (N=118)	Intervention (n=66)	Comparison (n=52)
	n (%), mean±SD	n (%), mean±SD	n (%), mean±SD
Gender			
Male	31 (26.3)	15 (22.7)	16 (30.8)
Female	87 (73.2)	51 (77.3)	36 (69.2)
Medical faculty			
AMC	59 (50.0)	34 (51.5)	25 (48.1)
VUmc	59 (50.0)	32 (48.5)	27 (51.9)
Study year			
BSc	76 (64.4)	32 (48.5)	44 (84.6)
MSc	42 (35.6)	34 (51.5)	8 (15.4)
Previous nutrition education			
No	41 (34.7)	29 (43.9)	12 (23.1)
Yes	77 (65.3)	37 (56.1)	40 (76.9)
Relevance of nutrition education in future practice (–2 to +2)	1.42±0.60	1.62±0.49	1.15±0.64
Benefit of more nutrition education (–2 to +2)	1.37±0.64	1.61±0.49	1.08±0.68

AMC, Amsterdam Medical Centre; VUmc, VU University Medical Centre.

intervention group, self-efficacy scores statistically significantly increased as compared with the comparison group, with 0.78 points (95% CI 0.62 to 0.95).

Table 4 shows the results of the linear regression analyses for the association between attitude towards nutritional counselling and the SELF course for the group of students in total, and stratified into men and women. Men's attitude scores statistically significantly increased in the intervention group as compared with the comparison group, with 0.50 points (95% CI 0.13 to 0.87). There was no statistically significant difference in women's attitude scores between the intervention and the comparison group.

DISCUSSION

The aim of this study was to investigate the effects of a nutrition education course on nutritional knowledge and intentions towards nutritional counselling in Dutch

Table 2 Paired t-tests on the preintervention and postintervention measurements for change in nutritional knowledge scores and attitude scores, social support scores, and self-efficacy scores towards nutrition counselling in the intervention and comparison group separately

	Intervention group (n=66)				Comparison group (n=52)			
	Preintervention	Postintervention	Difference score	Effect size	Preintervention	Postintervention	Difference score	Effect size
	Mean±SD	Mean±SD	Mean±SD	Cohen's d	Mean±SD	Mean±SD	Mean±SD	Cohen's d
Knowledge (0–13)	4.65±1.77	6.35±1.57	+1.70*±2.07	1.02	3.69±1.88	3.60±1.86	–0.10±1.86	0.05
Attitude (–2 to +2)	1.09±0.34	1.17±0.66	+0.07±0.67	0.15	0.86±0.32	0.86±0.39	<0.01±0.37	<0.01
Social support (–2 to +2)	–0.68±0.57	–0.48±0.64	+0.20*±0.59	0.33	–0.43±0.55	–0.53±0.64	–0.10±0.66	0.17
Self-efficacy (–2 to +2)	–0.13±0.52	0.71±0.48	+0.84*±0.56	1.68	0.15±0.45	0.06±0.51	–0.09±0.44	0.19

*P<0.05.

Table 3 Linear regression analyses for the association between nutritional knowledge (0–13), social support (–2 to +2) and self-efficacy (–2 to +2) towards nutrition counselling and the SELF course in Dutch medical students (N=118)

	Knowledge			Social support						Self-efficacy		
	Model 1			Model 1			Model 2			Model 1		
	Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Constant	2.31	0.37	1.58 to 3.05	–0.30	0.09	–0.47 to 0.12	–0.29	0.09	–0.46 to 0.11	–0.01	0.06	–0.14 to 0.11
Intervention	2.42	0.31	1.81 to 3.02	0.18	0.11	–0.04 to 0.39	0.20	0.12	–0.02 to 0.43	0.78	0.09	0.62 to 0.95

Model 1: adjusted for preintervention scores of the dependent variable.
Model 2: additionally adjusted for study year.
SELF, Students Experienced in Lifestyle and Food.

medical students. The results showed that a nutrition education course of 25 contact hours distributed over 10 weeks improved the nutritional knowledge, attitudes in men and self-efficacy towards nutritional counselling in Dutch medical students. To the best of our knowledge, the current study is the first study on the effects of nutrition education in Dutch medical students. The results of our study are largely in line with those of other studies. Increases in nutritional knowledge after completion of a medical nutrition education intervention were also reported in a study of Maiburg and colleagues.[9] Others have shown similar improvements in self-efficacy towards nutrition and lifestyle counselling.[4 21] However, most studies found no gender differences in outcomes, whereas this study observed only improvements in attitudes in male students.[15 17] Comparison of the findings on social support towards nutrition and lifestyle counselling with similar intervention studies involving medical students is problematic because those studies did not include social support as an outcome variable.

Although nutritional knowledge in the intervention group increased, on average it still remained low. A medical nutrition education study by Sjarif and colleagues[22] found a greater increase in nutritional knowledge in medical students observed in our study. Their intervention group received comprehensive and integrated interactive lectures with additional multidisciplinary lectures on oral–motor skill development and behavioural approaches to feeding problems. A hands-on workshop using real cases shown on recorded video and role-play sessions was also presented to the intervention group. A combination of interactive practical sessions and lectures as opposed to merely lecture-based classes could have improved the gains in nutritional knowledge of the participants of the SELF course. The importance of experiential learning in teaching is also confirmed by others who concluded that progression from a student to a health professional relies on experiential learning and participation.[6] Furthermore, our findings confirm the results of others who showed that nutritional knowledge of medical students is poor and support the need to include meaningful nutrition education into all phases of medical training.[3 8 9 23 24] Social support was also still perceived to be poor on completion of the SELF course. The lack of significant effect of the SELF course on social support likely signifies that in total, too few medical students participated in the course to benefit social networks. To improve social support, committed participants of the medical nutrition education intervention could have received training to disseminate key nutrition-related messages to their social networks.[8] In contrast, most participants already had positive attitudes at preintervention. Similar findings of positive attitudes towards nutrition counselling in medical students have been previously observed.[3 17 25] The positive attitudes of medical students are an important finding, given that students' attitudes and behaviours are determinants of dietary counselling practices as physicians.[4 26] Self-efficacy scores in the intervention group significantly improved and changed from negative to positive (from −0.01 to 0.78 on a scale from −2 to +2). The importance of self-efficacy was noted in a previous study of nutrition counselling behaviour in which self-efficacy was associated with greater incidence of addressing nutrition.[21]

The results of this study should be considered in the context of its strengths and weaknesses. A strength of this study was the inclusion of a comparison group. Also, the SELF course was developed in cocreation sessions with medical students, health professionals and nutrition academics to assess potential participants' needs and interests to guarantee a broad and relevant medical nutrition education angle.[27] A potential weakness is the lack of randomisation, which was difficult to organise in a group of students participating in a voluntary extracurricular course, and that participating students had to pay a small fee to participate in the optional course, further emphasising their expression of interest and commitment to nutrition education. Intrinsically motivated students may benefit more from a course than those students who are less interested. Otherwise, motivated students may start with a relatively high level of knowledge and skills and therefore may actually benefit less than students with fewer knowledge and skills. Another weakness refers to socially desirable answers in the questionnaires, which may not reflect the real impact of the course on future clinical management.[4 27] Clinical examinations or patient outcomes would have been preferable, but these methods can be costly in both time and resources.[16]

Table 4 Linear regression analyses for the association between attitude (−2 to +2) towards nutrition counselling and the SELF course in Dutch medical students for the group in total (N=118) and stratified into men and women

	Total (N=118)			Men (n=31)						Women (n=87)					
	Model 1			Model 1			Model 2*			Model 1			Model 2†		
	Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Constant	0.44	0.15	0.15 to 0.74	0.32	0.21	−0.12 to 0.76	0.15	0.29	−0.44 to 0.74	0.54	0.19	0.16 to 0.93	0.19	0.24	−0.28 to 0.66
Intervention	0.19	0.11	−0.02 to 0.40	0.53	0.18	0.17 to 0.89	0.50	0.18	0.13 to 0.87	0.08	0.13	−0.18 to 0.33	0.04	0.14	−0.24 to 0.31

Model 1: adjusted for preintervention scores of the dependent variable.
*Model 2: additionally adjusted for study year and previous nutrition education.
†Model 2: additionally adjusted for medical faculty and study year.
SELF, Students Experienced in Lifestyle and Food.

Since we compared the results with a comparison group, we suppose that it is improbable that the effects that we observed can be attributed to social desirability bias.

This study adds to earlier work by illustrating important areas of focus for implementation and evaluation of a nutrition education intervention for medical students. It supports the feasibility of implementing a brief, low-intensity nutrition education course as a method to improve medical students' nutritional knowledge and stimulated their intentions towards nutrition counselling. The SELF course was developed merely as a first step to offer additional nutrition education to Dutch medical students and can provide a guide for future improvement of the standard medical curriculum. The current SELF course consists of 25 contact hours and is offered as a voluntary extracurricular course of 10 consecutive weeks. If medical schools decide to focus more on nutrition in their curriculum, we would recommend them to integrate the nutrition topics into existing classes or topics during a longer period of time. For example, when teaching classes about diabetes, they could also pay attention to the nutritional aspects of diabetes, or as part of the courses on cardiovascular or gastrointestinal health they could devote some of the time to nutritional aspects. This will prevent repetition of basic topics, thereby limiting an extra time burden, while at the same time working to create an awareness among future doctors that nutrition is an important factor in many diseases. Furthermore, spreading out the nutrition topics over a longer period of time provides the opportunity to reinforce, apply and practice counselling skills along the curriculum. It will also be necessary to provide medical students opportunities for internships and residencies where they can reinforce, apply and practise their knowledge and skills in nutrition. This will prevent nutritional knowledge and skills from fading over time. In addition, in response to the demand of students, some medical schools in the Netherlands have recently introduced elective courses in nutrition in the second year of medical training. Further research is needed to evaluate the long-term impact of nutrition education curricula on medical students' real-time and/or simulated dietary counselling performance, physician practice patterns and eventually patient outcomes.

Acknowledgements The authors acknowledge Wilma RW Oosthoek, Founder Student and Nutrition Foundation, for internal peer review.

Contributors HLC contributed to and coordinated the design of the study, was responsible for the execution of the experiment, collected and carried out the data analysis, and wrote the manuscript. SCD and JCS developed the design of the study. SCD and JCS reviewed and critiqued the manuscript. All authors approved the final version of the manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study was conducted according to the ethical standards declared in the Helsinki Declaration of 1975, as revised in 2000, and approved by the Medical Ethics Committee of the Vrije Universiteit (VU) Medical Centre Amsterdam (2018.345). Active informed consent was obtained from all participants.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data analysed in this study are available from the corresponding author in response to requests that comply with ethical principles of good research.

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