




## ORIGINAL COMMUNICATION

# Nutrition in medical education in Latin America: Results of a cross-sectional survey

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## Abstract

**Rationale:** The gap between the nutrition education provided to medical students and the nutrition competences and attitudes needed for doctors to provide effective nutrition care is a global concern. The goal of this study was to investigate the curricular content on nutrition education in Latin American medical schools and to evaluate the self-perceived knowledge, attitudes, and barriers to nutrition practice of final-year medical students.

**Methods:** Eighty-five public and private medical schools from 17 Latin American countries were invited to participate in the study. Two close-ended online questionnaires

consisting of 25 and 43 questions were sent to medical school directors. Quantitative variables were expressed as frequencies, percentages, mean  $\pm$  standard deviation, medians, and ranges.

**Results:** A total of 22 (26%) medical school directors responded, of which 11 schools (50%) offered stand-alone mandatory nutrition courses in preclinical and 8 (36%) in clinical years. The mean hours dedicated to nutrition education was 47 (range: 0–150). A total of 1530 of 1630 (94%) students from 12 countries responded. Students' average age was  $25 \pm 3$  years, and 59% were female. Most students agreed that improving patients' health through nutrition (91%) is important and that nutrition counseling and assessment should be part of routine care provided by all physicians (89%), but they lack the level of education and training required to address nutrition-related issues.

**Conclusions:** Positive attitude and interest in nutrition among final-year medical students is high, but nutrition education is not perceived as sufficient to adequately prepare doctors in the field of nutrition.

#### KEYWORDS

competency, malnutrition, medical education, nutrition

## CLINICAL RELEVANCY STATEMENT

Positive attitude and interest in nutrition among final-year medical students is high, but nutrition education is not perceived as sufficient to adequately prepare doctors in the field of nutrition. If this situation is not corrected, these future doctors may miss important opportunities to ameliorate chronic disease and improve patient outcomes.

## INTRODUCTION

The link between nutrition and disease has been studied since antiquity, and today a bidirectional relationship is well established. On the one hand, large prospective cohort studies and randomized trials have shown the benefits of good nutrition and healthy eating habits on reducing cardiovascular risk and preventing chronic disease, thus benefiting patients and healthcare systems.<sup>1</sup> On the other hand, malnutrition and disease-related malnutrition are a major public health problem in both industrialized and emerging countries.<sup>2,3</sup> These types of malnutrition are associated with increased morbidity and mortality, longer hospital stays, more frequent readmissions, and rising healthcare costs.<sup>4</sup> Despite the considerable economic and health burden, disease-related malnutrition remains highly prevalent and often poorly recognized and treated. Consequently, nutrition care should be viewed as an important aspect of patient care and be addressed by all healthcare professionals.

Healthcare systems seek to promote healthy eating behaviors and optimal hospital nutrition care, thus demonstrating that it is an emerging priority to improve public health. As a result, the World

Health Organization has recommended that medical professionals should be supported in taking an active role to promote healthy eating habits.<sup>5</sup> Other institutions, such as the Council of Europe have expressed the need to improve nutrition care or attention in the clinical setting in which doctors and health professionals have a central role.<sup>6</sup> Medical authorities have confirmed that it is the responsibility of physicians to address nutrition-related problems affecting patients and the general population.<sup>7</sup> According to nutrition experts, these conditions account for over 25% of all visits to primary care providers.<sup>8,9</sup>

In order for physicians to provide counseling on healthy eating habits and optimal nutrition care, knowledge and skills in nutrition must be developed throughout undergraduate and graduate medical education. However, as reported by Crowley et al, there is consistent evidence that shows a gap between the nutrition education provided to medical students and the nutrition competencies and attitudes required for doctors to provide effective and efficient nutrition care.<sup>10</sup> Inadequate nutrition education in medical schools around the world is a widely recognized problem and has been continually reported since the 1950s.<sup>6,8,11–16</sup> Studies have shown that both graduating medical students and practicing physicians claim to have received inadequate nutrition education and do not feel well prepared to address this issue in clinical practice.<sup>17–25</sup>

To our knowledge the status of nutrition education in medical schools and student attitudes and knowledge thereof in Latin America has never been evaluated. Thus, the goal of this study was to evaluate the current status of nutrition education in Latin American medical schools as well as the self-perceived knowledge, attitudes, and barriers to nutrition practice of final-year medical students.

## METHODS

### Design study

This international cross-sectional study was conducted between January 2019 and August 2020 and was approved by the Research Ethics Committee of the Universidad El Bosque, (UEB 003–2019). All participants provided written informed consent. Confidentiality was guaranteed to all institutions and students.

### Participants

Eighty-five medical schools from 17 Latin American countries were invited to participate in the study. Public and private institutions were invited after being recommended by clinical nutrition experts and/or the president of the national society of clinical nutrition. The invitation to participate in the study was sent by email to the dean or director of medical schools, who were then instructed to respond to questionnaire 1 and to then send the link to questionnaire 2 by email to all their final-year medical students. Our choice of these participants was premised on the assumption that these groups of students have experienced the entire curriculum and are close to practicing medicine.

The medical schools that answered 100% of questionnaire 1 were included in the study. The participation of an institution's final-year medical students was included in the study if at least 5% of the total of the final-year students answered questionnaire 2.

### Questionnaires

The survey instrument was 2 close-ended online questionnaires. Questionnaire 1 surveyed the curricular content on nutrition, and questionnaire 2 surveyed the self-perceived knowledge, attitudes, and barriers to nutrition practice of final-year medical students. As no previously validated curricular content test nor nutrition knowledge tests have been developed specifically for medical students, we developed the instruments based on previous studies.<sup>11,17,21,25</sup> For pilot testing, the 2 questionnaires were shared with 2 professors of nutrition at Universidad El Bosque. The survey was subsequently revised based upon their responses. Some changes made to the pilot survey included revising response options and eliminating some questions. Following these modifications, the final instruments comprised a total of 25 questions in questionnaire 1 and 43 questions in questionnaire 2, and each took ~15–30 min to complete. The instrument was translated into Portuguese. Institutions that were invited but did not respond were sent at least 2 additional follow-up emails, and the reasons for nonparticipation were registered.

We are aware that self-perceived competencies would not necessarily reflect the actual competencies of these final-year students. However, we consider that assessing self-perceived competencies has its merits as it is proposed as a component in the concept of self-

efficacy, and may provide an indication to the participant's motivation in maintaining and improving these skills.<sup>26–28</sup> Thus, self-perceived competences have been accepted as an indicator of competence in health professionals when the domains of investigations are clearly specified.<sup>26,29</sup>

### Questionnaire 1: Nutrition education at Latin American medical schools

Questionnaire 1 was adapted from previous United States and European surveys and was addressed to the directors of medical schools who were instructed to respond to the online questionnaire or to delegate it to the person who knows the curriculum best.<sup>11,17</sup>

Questionnaire 1 consisted of 3 sections. Section 1 (11 questions) collected the characteristics of the respondent, the institution (ie, university), and the medical school. The second section (11 questions) assessed nutrition instruction in preclinical years. In this section, respondents were asked to estimate the number of contact hours of required or elective nutrition instruction in their medical schools, to indicate in what type of course nutrition was taught (nutrition, physiology, biochemistry, etc), and to provide specific information about course titles, instructors/professors, and methodology. In addition, respondents were asked their opinion on whether they considered the nutrition teaching in their medical school curriculum to be sufficient. The third section (3 questions), assessed the presence of postgraduate programs in nutrition.

### Questionnaire 2: Final-year medical school students self-perceived knowledge, attitudes, and barriers to practicing nutrition

Questionnaire 2 included questions from the study of Vetter et al and from the international research priorities for medical nutrition education by Ball L. et al<sup>21,29</sup> This questionnaire was addressed to final-year medical students and included 43 questions assessing the attitudes, self-perceived proficiency, knowledge, and barriers to nutrition practice of final-year medical school students. Questionnaire 2 consisted of 3 sections. Section 1 (11 questions) was used to collect the students' demographic information. The second section (11 questions) assessed their attitudes about, proficiency in, and barriers to nutrition. Eighteen questions asked for attitudes about and proficiency in nutrition and possible responses varied from "strongly disagree" to "strongly agree" on a five-point Likert scale. Responses of "agree" and "strongly agree" were regrouped in the category "positive attitude." Through 8 yes/no questions, students were asked about their perceived barriers to the application of nutrition knowledge. In the third section (21 questions), students were asked about self-perceived nutrition knowledge in basic, public health nutrition and clinical nutrition with yes/no questions. This organization has been considered as useful to shape teaching of the broad subject of nutrition throughout the medical curriculum.<sup>30</sup> The

**TABLE 1** Basic information on responding medical schools

Country	Number of responding medical schools <sup>b</sup>	Number of medical students per medical school <sup>a</sup>	Number of medical students in final year per medical school <sup>a</sup>	Duration of preclinical phase <sup>a</sup>	Duration of clinical phase <sup>a</sup>
Argentina	2	1580 ± 2008	70 ± 42	3	3.5 ± 0.7
Chile	1	2190	200	5	2
Colombia	7	884 ± 373	129 ± 72	2.5 ± 0.5	3.3 ± 0.5
Costa Rica	2	924 ± 308	114 ± 47	2.3 ± 0.4	3
Cuba	1	4556	420	2	4
Ecuador	2	5000 ± 2828	450 ± 71	2.5 ± 0.7	2.5 ± 0.7
El Salvador	1	450	30	3	4
Guatemala	1	1100	149	3	3
Mexico	2	391 ± 440	99 ± 27	3.5 ± 2.1	3 ± 0.7
Paraguay	1	800	150	5	3
Peru	1	450	50	2	5
Dominican Republic	1	1260	162	1.5	3.75
<b>Total</b>	<b>22</b>	<b>1490 ± 1635</b>	<b>160 ± 128</b>	<b>2.5 ± 1</b>	<b>3 ± 0.5</b>

<sup>a</sup>Values are mean and ± standard deviation.

<sup>b</sup>Values are frequencies.

final-year medical student survey was anonymous, and all data were deidentified.

## Statistical analyses

All data were collected in Google spreadsheets. Frequencies and percentages were used to describe qualitative variables. Quantitative variables were described by mean, median, rank, and standard deviations. Subgroups analyses contemplated variables of country and medical phase. The statistical software employed was SPSS 20, licensed to Universidad El Bosque.

## RESULTS

### Nutrition instruction in Latin American medical schools

In total, 26 of 85 (31%) invited medical schools participated in the study. Four institutions did not answer questionnaire 1 but participated with questionnaire 2. Thus, for the analysis of questionnaire 1, we included 22 medical schools from 12 Latin American and Caribbean countries. Colombia had the greatest number of participant institutions. Regarding the characteristics of the medical schools, 15 (68%) were private institutions, 12 (55%) had up to 10,000 medical students, and 3 (14%) had >50,000 students. The mean number of medical students was 1490 ± 1635 (median, 940; range, 80–7000) and the mean

number of medical students in the last year was 160 ± 128 students (median, 144; range, 30–500). The medical program had an average duration of 6 years. Table 1 shows the basic information on responding medical schools per country, including their total number of medical students and the duration of their preclinical and clinical formation.

The reason for nonparticipation in the study was explored. The majority of the directors did not give a reason ( $n = 58$ ; 98%). One director answered that they did not participate because their students were not exposed to any nutrition instruction.

The survey assessed the phase of medical training in which nutrition is instructed, showing that it mainly takes place during the preclinical years with a mean of 34 ± 33 hours. The mean hours dedicated to nutrition instruction across all medical training (preclinical and clinical courses) was 47 ± 41 hours (median, 41; range, 0–150). Table 2 shows the distribution of the instruction hours on nutrition in the medical school curriculum. Nutrition instruction in the preclinical and clinical years was absent in 7 (32%) and 5 (23%) of medical schools, respectively. In half of the medical schools, nutrition lectures were part of the dedicated mandatory nutrition courses in the preclinical years ( $n = 11$ , 50%), and few had any in the clinical years ( $n = 8$ , 36%). Very few responding medical schools ( $n = 4$ , 18%) had an elective and independent nutrition course in preclinical and clinical years. Medical schools integrated nutrition education in different courses in preclinical and clinical years. Table 3 shows the distribution of the instruction hours on nutrition in different disciplines.

Very few medical school directors believed that their nutrition instruction hours are sufficient to prepare future doctors ( $n = 2$ , 9%), and few believe that their medical graduates are competent to solve

**TABLE 2** Distribution of instruction hours on nutrition in responding medical schools' curriculum

Curriculum	Preclinical phase	Clinical phase
Nutrition education <sup>a</sup>	15 (68)	17 (77)
Dedicated mandatory nutrition course <sup>a</sup>	11 (73)	8 (47)
Elective nutrition course <sup>a</sup>	4 (27)	4 (24)
Total nutrition education in hours <sup>b</sup>	34 ± 33	27 ± 29
Nutrition education in integrated courses <sup>a</sup>	14 (93)	15 (88)

Note: Deans were asked respond "yes" or "no" to questions regarding nutrition instruction. The percentage of affirmative answers is shown.

<sup>a</sup>Values are frequencies and (%).

<sup>b</sup>Values are mean and ± standard deviation.

**TABLE 3** Distribution of integrated nutrition education per course

Phase	Course	n (%)
Preclinical phase <sup>a</sup>	Semiology <sup>b</sup>	11 (79)
	Physiology	12 (86)
	Biochemistry	13 (93)
	Other courses	10 (71)
Clinical phase <sup>a</sup>	Pediatrics	15 (100)
	Gastroenterology	10 (67)
	Surgery	12 (80)
	Endocrinology	11 (73)
	Intensive care	6 (40)
	Geriatrics	7 (47)
	Cardiology	6 (40)
	Internal Medicine	14 (93)
	Oncology	10 (67)
	Nephrology	9 (60)
	Other courses	5 (33)

Note: Medical schools could offer nutrition education in > 1 course.

<sup>a</sup>Values are frequencies and (%).

<sup>b</sup>Study of signs.

nutrition problems (n = 6, 27%). One school (5%) did not offer any nutrition education.

We surveyed the professors dedicated to nutrition instruction in the medical schools, showing that the mean of professors giving nutrition lectures was 5 ± 7. Most of them were physicians (n = 19, 86%), dietitians/nutritionists (n = 13, 59%), and a few nurses (n = 2, 9%).

In most of the medical schools, the professor level/degree of studies consisted in a few days of clinical nutrition training (n = 18, 82%), a Master's degree (n = 11, 50%), and specialization (n = 14, 63%). Any of the institutions have professors with a PhD degree. Concerning postgraduate courses in nutrition offered by the institution, about half of the medical schools (n = 10, 46%) had extension courses and few (n = 7,

32%) had postgraduate programs: 6 medical schools offered a Master's degree and 4 offered a specialization in nutrition or clinical nutrition.

### Final-year medical school students' self-perceived knowledge, attitudes, and barriers to practicing nutrition

A total of 1630 final-year medical students from 26 medical schools were invited to respond to questionnaire 2. Most of the students were willing to participate (n = 1530, 94%), of which more than half (n = 903, 59%) were female, and had an average age of 25 ± 2.8 years. Most of the responding students (n = 1255, 82%) had prior nutrition exposure defined as either having taken an elective or mandatory course. Only half (n = 765, 50%) knew that the medical school offered an elective nutrition course.

Most of the students had a positive attitude (>80%) towards nutrition care in medical practice, but only half (n = 831, 54%) thought that the training and education they received was adequate and will allow them to discuss nutrition issues with their patients. Lack of education and training is the most frequent perceived barrier to adequately practice nutrition care. Table 4 shows the attitudes, self-perceived proficiency, and barriers to nutrition practice.

Self-perceived knowledge in 3 domains including basic nutrition, public health nutrition, and clinical nutrition varied from 27% to 99%. (Table 5).

## DISCUSSION

Despite a worldwide recognized need for doctors to understand the inextricable relationship between nutrition and health, poor education for these professionals has been reported.<sup>10</sup> In this study, nutrition education in medical schools was assessed in Latin America for the first time. Final-year students reported a positive attitude towards nutrition, recognizing their role in nutrition care. However, half of them do not feel prepared to discuss nutrition issues with their patients. Moreover, the majority think there is not enough nutrition training for doctors, consistent with the main perceived barrier of lack of education and training. This is in line with most medical directors' opinions that nutrition education is not sufficient to adequately prepare doctors in this field.

Our results are in line with previous studies. Crowley et al reported deficiency of nutrition education in physicians' training worldwide in a systematic review.<sup>10</sup> They showed that, despite the centrality of nutrition to a healthy lifestyle, medical students are not supported in providing high-quality and effective nutrition care. These findings were obtained from 24 studies throughout all geographic regions (the USA, Europe, the Middle East, Africa, Australia, and New Zealand) except Asia and Latin America. It is important to notice that each geographic region has unique nutrition challenges and opportunities that must be addressed appropriately by medical professionals. Latin America is a region particularly affected by hunger, noncommunicable diseases, and

**TABLE 4** Positive attitude, proficiency, and perceived barriers to practicing nutrition

Responses	Total n = 1530	
	N	%
<b>Attitude</b>		
As a physician, it is my responsibility to advise patients about diet and nutrition.	1402	92
I have an obligation to improve the health of my patients, even through nutrition counseling.	1397	91
All physicians, regardless of specialty, should advise high-risk patients about making dietary changes.	1396	91
Nutrition counseling should be part of the routine care of all physicians, regardless of their specialty.	1361	89
Nutrition assessment and counseling should be included in any routine visit.	1316	86
I can apply what I have learned about nutrition to my work.	1234	81
My training and education has adequately enabled me to discuss nutrition issues with my patients.	831	54
During consultation, physicians have little impact on the patient's ability to lose weight.	735	48
I think there is enough nutrition training for doctors in my country.	281	18
I can not waste time on nutrition counseling.	133	9
<b>I feel comfortable and competent...</b>		
Discussing the benefits of exercise and nutrition for health and wellness.	1327	87
Giving dietary advice to patients with type 2 diabetes.	1258	82
Doing nutrition counseling in daily practice.	1009	66
Assessing water demands depending on the level of physical activity or health.	988	65
Providing nutrition strategies to patients who lose weight because of chronic disease.	928	61
In identifying patients who need nutrition supplements.	869	57
Applying nutrition screening tools.	851	56
Providing examples of numbers and serving sizes for each food group.	789	52
Identifying patients who need diet therapy.	753	49
Identifying patients who need enteral or parenteral nutrition therapy.	695	45
Carrying out an adequate nutrition evaluation.	612	40
<b>Barriers</b>		
Lack of education and training.	1454	95
Lack of time in medical consultation.	1368	89
Lack of interest from patients.	1222	80
Lack of confidence in the efficacy of the interventions.	1150	75
Consider that the advice on feeding interferes with the privacy of the patient.	790	52
Lack of financial compensation or payment for the doctor.	814	53

Note: Students were asked to indicate their degree of agreement to questions regarding attitude, self-comfort, and barriers to clinical nutrition practice. The percentage of favorable attitude answers is shown.

malnutrition in all forms.<sup>31</sup> In 2019, 47.7 million people (ie, 7.4% of the population) suffered from hunger, and 2.8 million deaths (ie, 75%) in the region were due to noncommunicable diseases.<sup>32</sup> Considering that the impact of the coronavirus disease 2019 (COVID-19) pandemic suggests a significant increase will occur in hunger, food insecurity, and malnutrition in the coming years and that it has been recognized that nutrition status (ie, obesity, malnutrition, micronutrients deficiencies) appears to be a relevant factor influencing patient outcome,<sup>33</sup> it is imperative that doctors should be more prepared than ever to face these situations.

Currently, there is no international consensus on the minimum number of hours required for nutrition education in medical schools.<sup>10</sup> In

1985, the (US) National Research Council Committee on Nutrition in Medical Education recommended including at least 25–30 classroom hours of nutrition education in the undergraduate medical curriculum to adequately cover a set of basic core concepts in preclinical years (ie, energy balance, role of specific nutrients and dietary components, nutrition in the life cycle, nutrition assessment, and protein-energy malnutrition).<sup>34</sup> In 1989, The American Society of Clinical Nutrition's (ASCN's) national consensus of medical educators proposed a minimum of 44 h for nutrition education.<sup>35</sup> Recently, the European Society for Clinical Nutrition and Metabolism's (ESPEN's) Nutrition in Education in Medical Schools (NEMS) initiative recommended increasing the number of teaching hours but without fixing a minimum of hours.<sup>30</sup> In

**TABLE 5** Knowledge of nutrition

I know...	Total n = 1530	
	N	%
<b>Basic nutrition</b>		
How to calculate body mass index	1508	98.6
The role of dietary cholesterol and saturated fat in increasing blood lipid	1355	88.6
The role of $\omega$ -3 and $\omega$ -6 fatty acids in cardiovascular prevention	1242	81.2
The role of genetics, diet, and medications to lose weight	968	63.3
The pathophysiology of malnutrition	1193	78.0
The pathophysiology of sarcopenia	795	52.0
<b>Public health</b>		
The economic impact of malnutrition associated with disease on health systems	1063	69.5
The dietary guidelines of my country	599	39.1
The public policies on nutrition in my country	406	26.5
<b>Clinical nutrition</b>		
The impact of malnutrition associated with disease on clinical outcomes of patients	1231	80.5
The most important elements of nutrition diagnosis	1028	67.2
The indications and contraindications of enteral nutrition	922	60.2
The indications and contraindications of oral supplements	877	57.3
The indications and contraindications of parenteral nutrition	846	55.3
The main tools for nutrition screening	688	45.0
The types and uses of pharmaconutrients used in enteral nutrition	562	36.7
The types and uses of pharmaconutrients used in parenteral nutrition	499	32.6

Note: Students were asked respond "yes" or "no" to questions regarding self-perceived knowledge in the domains of basic, public health, and clinical nutrition. The percentage of affirmative answers is shown.

our study, we found a mean of  $47 \pm 41$  (median, 41; range, 0–150) hours dedicated to nutrition instruction, of which  $34 \pm 33$  hours are in pre-clinical years and  $27 \pm 29$  hours in clinical years, but with great variability among institutions. Our results are higher than those found in the literature. This can be explained by the fact that medical schools with potentially more hours of nutrition education participated in the study. Adams et al has been reporting the results of a US National survey that has been repeated every 4 years since 2000.<sup>11,15</sup> The latest published data show a mean contact hour of  $19 \pm 13.7$ , and a median total nutrition instruction remaining  $\leq 20$  hours in 121 US medical schools since 2000.<sup>15</sup> In Japan, the length of the dedicated nutrition course varied from 1 to 56 hours in 25 medical schools surveyed.<sup>36</sup> Using the same instrument of the US survey, Chung et al reported  $23.68 \pm 17.6$  contact hours in the complete curriculum in 32 European medical schools (pre-clinical phase  $14.0 \pm 12.4$ , clinical phase of the medical training  $9.4 \pm 10.7$ ).<sup>17</sup>

In view of the lack of a consensual international reference for an adequate amount of nutrition education, we wonder if our results are sufficient to prepare future doctors for nutrition care. This seems unlikely given that similar to Europeans,<sup>17</sup> in accordance with US opinion,<sup>11</sup> the directors in our study expressed the belief that nutrition hours were insufficient. The required level of nutrition knowledge should be evaluated.

Our study showed that the self-perceived knowledge surveyed in 3 different domains including basic nutrition, public health nutrition, and clinical nutrition varied largely according to the question. For example, most of the students knew about the body mass index, but very few knew about public policies on nutrition or nutrition screening. Important variations and inadequacy of knowledge were also reported in previous studies assessed objectively or subjectively.<sup>19,37–41</sup> Acknowledging that there is no global consensus on the required level of nutrition knowledge for medical students nor a globally accepted reference of a basic content curriculum, it is challenging to determine the adequacy of this knowledge. In the USA and Europe, programs have been developed that include the basis of a core curriculum in nutrition. In 1989, the ASCN established guidelines for nutrition core content in medical school curriculums, establishing 41 nutrition topics, of which 26 were identified as priorities.<sup>35</sup> Recently, the ESPEN NEMS initiative determined a "minimum curriculum knowledge" in nutrition and recommends teaching nutrition in 3 domains: basic nutrition, public health nutrition, and clinical nutrition.<sup>30</sup> The number of hours, as well as the required level of nutrition knowledge, should be established as a global benchmark for universities, as suggested by others.<sup>10</sup>

The results of the final-year students' attitude towards nutrition in the present study are consistent with previous studies, which reported that nutrition care is perceived to be important by medical



students.<sup>19,42-44</sup> Previous research has reported that the positive attitude of new medical students toward nutrition is lost after preclinical training and is only partially regained after the clinical years.<sup>45</sup> The fading interest of medical students can be explained by a lack of role modeling teaching about incorporating nutrition care into medical practice.<sup>46</sup>

It should be noted that there are 3 main limitations to the study. First, a low response rate of medical directors was obtained. The lack of nutrition education in medical schools and the directors being apprehensive about dread of scrutiny and evaluation could explain the low response rate. Second, sampling bias may have had an impact on the survey results. The universities with nutrition in the curriculum and leading nutrition teachers might have been more inclined to participate in this study. Third, the questionnaires have been developed based on previous studies and not on validated tools. We are aware that a survey tool has been validated to assess nutrition knowledge, skills, and attitude towards nutrition among primary care practitioners, including dietitians and general practitioners.<sup>29</sup> However, no specific tool for undergraduate medical students reflecting the received education without any influence of knowledge generated by experience have been developed.

## CONCLUSION

Nutrition is insufficiently incorporated into medical education with important heterogeneity among institutions. Despite the fact that the final-year medical students recognized the centrality of nutrition and consider that nutrition care is part of their responsibilities, they lack the level of education and training required to address nutrition-related issues in their patients. Recognizing that people without access to healthy diets and hospital nutrition care live in all regions of the world, the gap between the nutrition education provided to medical students and the nutrition competence and attitudes needed for doctors to provide effective and efficient nutrition care is a global problem that affects us all.

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## CONFLICT OF INTERESTS

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## AUTHOR CONTRIBUTIONS

Diana Cardenas contributed to the conception of the research, the analysis and interpretation of the data and drafted the manuscript; Gustavo Díaz contributed to the conception of the research, and the acquisition and analysis of the data; Jessika Cadavid, Fernando Lipovestky, Marisa Canicoba, Paola Sánchez, Ludwig Álvarez, Yan Duarte, José Guillermo Gutiérrez Reyes, Gilda Miranda de Noyola, Claudia Maza, Sergio Santana Porbén, Charles Elleri Bermúdez, Yawelida García, and Isabel Calvo contributed to the acquisition, analysis, and interpretation of the data; Humberto Arenas contributed to the acquisition, analysis, and interpretation of the data and critically revised the manuscript. All authors critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

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