
ORIGINAL ARTICLE

Influence of cooking skills and nutritional training on dietary choices of incoming chiropractic students

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Objective: We aimed to identify chiropractic students' cooking skills, perceptions of healthy eating, and influence of prior nutrition training on dietary intake.

Methods: Two cohorts of incoming graduate students were surveyed to assess nutritional training prior to matriculation, perceptions of healthy eating behaviors, cooking skills, current dietary intake, and barriers to healthy eating. Using independent *t* tests, correlations, and descriptive statistics, data from the cohorts were assessed.

Results: The response rate was 88.7% ($n = 178$). Nutritional training significantly increased perception of nutritional knowledge and confidence in giving nutrition advice. Completion of at least 1 college nutrition course was associated with nearly double students' weekly fatty fish intake. Males were more likely to eat animal protein, and females preferred desserts. Modeling a healthy diet for future patients was rated as being important, yet most students consumed diets consistent with the typical American diet. The leading barriers to healthy eating included lack of time and money.

Conclusion: Similar to students in other healthcare professions, incoming chiropractic students wish to model healthy behaviors but fail to apply their knowledge and attitudes to their own dietary intakes due to common barriers.

Key Indexing Terms: Chiropractic; Students; Dietary Habits; Cooking; Education

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INTRODUCTION

The high-fat and high-sugar properties of the standard American diet negatively impact the health of the public, with far-reaching effects on cuisine across the globe. Although there have been countless efforts to educate the public to make healthier choices, the United States continues to have rising healthcare costs from preventable, diet-related chronic disease.¹ According to the Centers for Disease Control and Prevention (CDC), 7 out of the 10 most common causes of death are due to chronic, preventable diseases.² Treating people with chronic diseases utilizes 86% of the United States' annual healthcare costs.² Research shows a direct relationship between unhealthy dietary choices and chronic, noninfectious diseases, such as coronary heart disease, cerebrovascular disease, diabetes mellitus, multiple cancers, several bone and joint diseases, and dental caries.³ Years of unhealthy habits accumulate, increasing the likelihood of chronic disease development.⁴

Contributing factors that account for the increasing trend of diet-related diseases include globalization, urbanization, cheap fast food, global mass media, and the shift

in occupations that require less physical labor and allow for more leisure time.⁵ The combination of economic development, technological innovations, and increased marketing changed dietary preferences toward those of convenience foods high in fat and carbohydrates and low in fiber.^{6,7} As predilection for grab-and-go foods increases, cooking skills begin to lag. Evidence shows that confidence in perceived cooking skills are associated with slightly higher dietary quality.^{8,9}

Nearly all chiropractic colleges provide at least 2 dedicated nutrition courses in the curriculum, providing nearly 90 contact hours before graduation. Previous research on dietary and health behaviors of chiropractic students is limited. The only published assessment of chiropractic student perception of health behaviors found that chiropractors and student doctors should be role models, but follow-through in the performance of health behaviors was greatly lacking.¹⁰

This study addresses dietary habits of incoming chiropractic students, including food intake, health perception, and dietary attitudes. As education is a cornerstone of behavior change, we assessed the relationship of formal coursework in nutrition with dietary habits and

Table 1 - Demographic Information and Previous Nutrition Education of Students Enrolled in a Chiropractic Graduate Program

	Participants (%)
Gender	
Male	105 (59)
Female	73 (41)
Age	
18–24 years	127 (71)
25–34 years	45 (25)
35–44 years	6 (4)
Prior nutritional training	
None	40 (22)
High school course	14 (8)
1 undergraduate course	68 (38)
2 or more undergraduate courses	53 (30)
Undergraduate degree in nutrition	3 (2)

health perception. The final aim of this research project was to determine the main factors influencing chiropractic students' diets and to identify helpful resources to support making healthier choices.

METHODS

Sample

Assessment of first-trimester chiropractic students occurred within the first 2 months of matriculating to the doctor of chiropractic program at Palmer College of Chiropractic. A convenience sample of all students enrolled in first-trimester Biochemistry I during the spring and summer 2017 trimesters were invited to participate. The study design was approved by the institutional review board (IRB X2017-5-4-N).

Survey

Dietary habits and perceived barriers were assessed with a survey developed by the authors. The survey was administered approximately halfway through the first trimester of the program. Following informed consent, the paper survey was administered during a well-attended course. For the food frequency questionnaire portion, a healthy diet was determined based on self-reported servings of vegetables, fruits, lean meats, and fish eaten, compared to current dietary guidelines.¹¹ Both cohorts were combined and analyzed together. Assessment of 19 items of perceived health habits were assessed using a 4-point Likert scale, ranging from strongly disagree to strongly agree. Cooking skills and health perception questions were scored as 1 through 4, except for reverse scoring negative questions. Ten items of dietary intake data were scored in the following manner: none = 0, 1–2 servings = 1, 3–4 servings = 3, 5–6 servings = 5, and 7+ servings = 7. Self-reported prior nutrition education was also assessed.

Statistical Analysis

Statistical analysis was used to determine associations between prior nutritional education and healthy eating

patterns. Data were analyzed using statistical software (Statistical Package for Social Sciences, version 22.0; IBM Corp, Armonk, NY). Descriptive statistics assessed demographic data and frequency of eating habits. Two-tailed independent *t* tests were utilized to analyze health behaviors in students completing at least 1 undergraduate nutrition course compared to less nutritional education, as well as differences in gender. Pearson's correlation was used to determine associations between individual health behaviors, cooking skills, and dietary intake. A 95% confidence interval was used, and $p \leq .05$ was considered significant.

RESULTS

In the combined cohorts, 203 students were eligible to participate. Of those, 178 students completed the survey, for a response rate of 88.7%. As reported in Table 1, respondents were primarily males aged 18–24 years. Nearly 70% of students had some undergraduate nutrition training before beginning the graduate program.

Survey results were found to be normal, and Cronbach α measurement of survey reliability was 0.74. Results of independent sample *t* tests examining gender and nutritional education levels on cooking skills and health perceptions are tabulated in Table 2.

Health Perception

Females were significantly more likely to recognize the importance of eating a plant-based diet (Table 2). All students recognize the importance of modeling a healthy diet for future patients, but few felt they were expressing their optimal health. Nearly a quarter of first-trimester students were currently satisfied with their diet, which leaves about 75% who recognize that their diet could be improved.

Prior Nutrition Education

Nutritional training had little effect on dietary patterns, apart from fish intake. Completion of at least 1 college nutrition course nearly doubled student weekly fatty fish intake. Fifty-three percent of students with less nutritional education and 42% of the entire cohort reported never consuming fish. Twenty percent of more educated students consumed 3 or more servings of fatty fish weekly, while only 10% of students with less nutritional training ate the same quantity. Nutrition-related knowledge following completion of at least 1 college nutrition course was significantly associated with an increase in comfort giving nutritional advice ($p = .002$, $r = 0.65$).

Cooking Skills

Gender and nutrition education did not influence overall results from the cooking skills domain. Within this domain, females were significantly more likely to know how to cook fresh vegetables ($p = .008$), but this did not translate into significantly higher vegetable intake ($p = 0.123$; Tables 2 and 3). The ability to cook a variety of dishes directly correlated with the perception of being a good cook ($r = 0.73$). Most students learned to cook at a

Table 2 - Summary of Independent-Samples *t* Tests to Examine the Influence of Gender or Nutrition Education on Cooking Skills, and Health Perception (*n* = 178)^a

Survey Question	Overall	Male		Female		P Value	<1 College Nutrition Course	1+ College Nutrition Course	p Value
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)		Mean (SD)		
Cooking skills									
I consider myself a great cook.	2.8 (0.6)	2.8 (0.6)	2.9 (0.6)	0.34	2.9 (0.6)	2.8 (0.6)	0.78		
I can cook a variety of dishes.	2.8 (0.8)	2.9 (0.8)	2.8 (0.9)	0.60	2.9 (0.9)	2.8 (0.8)	0.38		
There are only a few dishes I feel comfortable cooking. ^b	2.9 (0.8)	3.0 (0.8)	2.9 (0.8)	0.61	2.9 (0.8)	2.9 (0.8)	0.96		
I know many ways to cook fresh vegetables.	2.8 (0.8)	2.8 (0.8)	2.8 (0.8)	0.68	2.7 (0.8)	2.8 (0.8)	0.53		
I learned how to cook as a child or adolescent.	2.8 (0.8)	2.7 (0.8)	3.0 (0.8)	<0.01	2.8 (0.8)	2.8 (0.8)	0.85		
I learned how to cook as an adult.	2.7 (0.9)	2.6 (1.0)	2.8 (0.9)	0.31	2.8 (1.0)	2.7 (0.9)	0.59		
I learned how to cook from a family member.	2.7 (0.8)	2.7 (0.9)	2.6 (0.8)	0.23	2.8 (0.8)	2.6 (0.9)	0.41		
I taught myself how to cook.	2.9 (0.8)	2.9 (0.9)	3.0 (0.8)	0.21	3.1 (0.8)	2.9 (0.8)	0.17		
I don't like cooking and don't want to learn. ^b	2.8 (0.8)	2.8 (0.8)	2.8 (0.8)	0.87	2.8 (0.8)	2.6 (0.9)	0.70		
Health perception and resources									
I feel knowledgeable about nutrition.	3.6 (0.6)	3.7 (0.5)	3.6 (0.6)	0.19	3.6 (0.7)	3.7 (0.6)	0.63		
I am comfortable giving someone dietary advice.	3.0 (0.4)	3.0 (0.4)	3.1 (0.4)	0.36	2.9 (0.4)	3.1 (0.4)	0.02		
Eating a plant-based, nutritious diet is important to me.	3.1 (0.6)	3.1 (0.6)	3.1 (0.5)	0.39	2.9 (0.7)	3.1 (0.5)	0.02		
I consider myself a picky eater. ^b	2.7 (0.7)	2.8 (0.7)	2.6 (0.7)	0.06	2.4 (0.7)	2.8 (0.7)	<0.01		
I feel my diet is very healthy.	2.6 (0.8)	2.5 (0.9)	2.8 (0.8)	0.03	2.6 (0.8)	2.7 (0.9)	0.47		
I am satisfied with my current diet.	3.3 (0.9)	3.3 (0.8)	3.2 (0.9)	0.30	3.2 (0.9)	3.2 (0.9)	0.99		
I am concerned about preventing disease by eating a healthy diet.	2.8 (0.7)	2.8 (0.7)	2.8 (0.7)	0.99	2.8 (0.6)	2.8 (0.7)	0.60		
I care about maintaining a healthy lifestyle and eating well.	2.6 (0.8)	2.6 (0.8)	2.7 (0.8)	0.42	2.7 (0.8)	2.6 (0.8)	0.39		
It is important for me to model a healthy diet for my future patients.	3.0 (0.7)	3.0 (0.8)	3.1 (0.7)	0.33	2.9 (0.7)	3.1 (0.7)	0.21		
I feel I am expressing optimal health.	3.5 (0.6)	3.5 (0.6)	3.6 (0.5)	0.10	3.4 (0.6)	3.6 (0.6)	0.16		
I have enough money to buy fruits and vegetables and lean meats/fish.	3.6 (0.6)	3.5 (0.6)	3.6 (0.5)	0.63	3.5 (0.6)	3.6 (0.6)	0.11		
I don't eat healthy because I don't have enough time to cook. ^b	2.5 (0.8)	2.5 (0.8)	2.6 (0.9)	0.33	2.5 (0.7)	2.5 (0.8)	0.58		
	2.7 (0.8)	2.7 (0.8)	2.7 (0.9)	0.90	2.6 (0.8)	2.7 (0.8)	0.60		
	2.6 (0.8)	2.5 (0.9)	2.6 (0.9)	0.48	2.4 (0.9)	2.6 (0.9)	0.30		

^a Cooking skills and health perceptions were assessed utilizing a 4-point Likert scale, ranging from strongly disagree (1) to strongly agree (4).^b Question was reverse-scored.

Table 3 - Summary of Independent-Samples *t* Tests to Examine the Influence of Gender or Nutrition Education on Dietary Intake (*n* = 178)

Dietary Intake	Overall Mean (SD)	Male Mean (SD)	Female Mean (SD)	<i>p</i> Value	<1 College Nutrition Course	1+ College Nutrition Course	<i>p</i> Value
					Mean (SD)	Mean (SD)	
Daily fruit servings	2.4 (0.8)	1.8 (1.4)	1.9 (1.6)	0.72	1.9 (1.6)	1.8 (1.4)	0.65
Daily vegetable servings	2.5 (0.8)	1.9 (1.4)	2.2 (1.7)	0.17	1.9 (1.4)	2.1 (1.5)	0.45
Weekly intake of beef, pork or lamb	2.6 (1.0)	2.9 (1.9)	1.4 (1.5)	<0.01	2.2 (1.9)	2.3 (1.9)	0.66
Weekly intake of chicken or turkey	3.2 (1.2)	3.7 (2.2)	3.0 (2.1)	0.03	3.1 (2.1)	3.6 (2.2)	0.14
Weekly fatty fish intake	1.9 (1.0)	1.2 (1.6)	1.1 (1.6)	0.95	0.8 (1.2)	1.4 (1.7)	0.02
Weekly servings of plant-based protein	2.2 (1.0)	1.5 (1.8)	1.8 (1.9)	0.30	1.6 (1.6)	1.6 (1.9)	0.92
Weekly dessert consumption	2.1 (1.0)	1.2 (1.6)	1.9 (1.6)	0.01	1.9 (1.9)	1.4 (1.7)	0.13
Homemade meals eaten weekly	3.7 (1.2)	4.6 (2.3)	4.2 (2.3)	0.25	4.5 (2.3)	4.4 (2.3)	0.75
Weekly lunches brought from home	3.5 (1.4)	3.8 (2.8)	4.8 (2.2)	0.01	4.1 (2.5)	4.3 (2.7)	0.73
Weekly meals eaten out of the home	2.1 (0.8)	1.4 (1.3)	1.5 (1.3)	0.53	1.5 (1.3)	1.5 (1.3)	0.93

Dietary intake data was analyzed based on daily or weekly servings consumed, scored as: none = 0, 1–2 servings = 1, 3–4 servings = 3, 5–6 servings = 5, and 7+ servings = 7.

young age (60%) and from a family member (73%). Learning to cook at a young age was associated with the perception of being a good cook ($r = 0.59$) and with the ability to cook a variety of dishes ($r = 0.44$), but it did not correlate with any improvement in healthy dietary habits.

Dietary Intake

Dietary intake of this cohort of students was inadequate, as less than 10% of surveyed students met current recommendations for daily fruit and vegetable intake (Table 3). Most students reported eating 1–2 daily servings of fruits (59% of cohort) and vegetables (52% of cohort). Dietary intake data illustrated that male students ate significantly more red meat and poultry weekly compared to females, although, overall, red meat consumption was low, with the highest percentage of students recording 1–2 servings consumed per week (42%). Poultry consumption was higher, as 38% of students reported eating 3–4 servings per week. Females were significantly more likely to eat dessert; while 35% of males reported refraining from all desserts throughout the week. Women were also more likely to bring lunch from home daily. Twenty percent of males reported never bringing a lunch to school and were more likely to purchase food in the cafeteria. Most students surveyed consumed homemade meals at least 5 days per week (60%). Sixty percent of students reported purchasing food out of the home 1–2 times weekly, while 20% reported never ingesting fast-food, cafeteria, or restaurant fare.

Barriers to Healthy Eating

Correlation data unsurprisingly reported an inverse relationship between inadequate time for food preparation and the perception of having a healthy diet ($r = -0.48$). The greatest barriers to a healthier diet include lack of time (72%) and lack of money to purchase nutritious food (65%). Regarding resources that could be provided to improve dietary habits, 68% believed having access to weekly meal plan ideas and 59% thought meal prepping

tips would help. Healthy recipes and cooking tutorial videos were considered less helpful options.

DISCUSSION

When comparing the US Department of Agriculture (USDA) recommendations to the chiropractic student sample, 6% of students fell short of fruit recommendations, while 58% of students did not eat the recommended servings of vegetables.¹² When the dietary intakes of our student cohort are compared to the American Heart Association (AHA) recommendations, only 11.8% of students eat enough fruit and 10.1% eat enough vegetables.^{13,14} Surveillance data from the National Health and Nutrition Examination Survey (NHANES) found that 45% of 19- to 30-year-old men and 30% of similarly aged women consumed ≥ 5 daily combined servings of vegetables and fruits.¹⁵ Conversely, recent reports show that undergraduate students only consume an average of 1–2 servings of combined fruits and vegetables daily.^{16,17} Overall, our data indicate that this chiropractic student population consumes more fruits and vegetables than does the average college student.^{16–18} The fruit and vegetable intake of this chiropractic student cohort is also consistent with current NHANES data.

Red meat is not recommended by either the USDA or AHA, as it is a risk factor for cardiovascular disease, colorectal cancer, type II diabetes, and all-cause mortality.^{19,20} Consistent with previous data, our results showed that males eat significantly more red meat and poultry.^{10,21,22} Red meat consumption was negatively correlated with vegetable intake and the importance of eating a plant-based diet. In another cohort of chiropractic students DuMonthier et al.¹⁰ found that role modeling healthy behaviors and patient education were not as important to meat eaters versus non-meat eaters. However, the current study showed that eating meat had no influence over wanting to model healthy behavior for future patients, even if students' current dietary habits did not align with current nutritional recommendations.

Recent studies by Bruce et al.²³ show college-aged women consumed more sugar-sweetened snacks; similarly, females in our cohort of students consume more weekly desserts. Contrary to these findings, some studies have found that females, especially those in health science programs, consume less dessert.²⁴

Cooking is an essential life skill. Self-perception of cooking skills and timing of cooking skill development did not influence any eating behaviors nor dietary intake. A recent systematic review of cooking interventions during adulthood did not yield consistent results in dietary intake and health-related outcomes, although a lack of control groups was noted by the authors.²⁵ Cooking skills do not predict overall healthy dietary habits, but adults with better culinary skills often have higher fiber intakes.²⁶ Stage of life during cooking skill development alters the major fiber source consumed. Childhood learners ate more fruit and prepared foods with more fresh ingredients, while early adult learners consumed more vegetables.^{8,9}

Nutrition knowledge does not always translate into application, especially when various constraints are present. Research has shown that students often display less adherence to dietary recommendations, and educational interventions alone do not significantly influence dietary patterns of students.²⁷⁻²⁹ A recent dietary assessment of medical and pharmacy students in California noted that nutrition education increased student confidence in providing optimal nutrition recommendations, but they themselves failed to meet dietary guidelines.³⁰ Interestingly, studies suggest students are overconfident and overestimate their nutrition-related knowledge compared to graduates in practice.³¹ The same “perceived” versus “actual” nutrition knowledge and overconfidence may very well be a factor in the current cohort which is barely beginning a graduate program.

On the contrary, healthcare professional students often have healthier behaviors than do non-health studies students, often due to self-selection and learned behaviors.²⁴ Students with postsecondary education specifically in nutrition make significantly healthier food choices and have dietary intakes closer to national recommendations.²⁶ In the current cohort, nutrition education had little effect on adherence to a healthy dietary pattern, aside from a higher fish intake with more education. Although role modeling is important to all healthcare professional students, dietary adherence and follow-through are not prioritized during their education due to barriers inherent to the rigor of programmatic work, as seen in this study.^{10,30,32}

Planning and preparation are ultimately keys to successful health habits, both of which are often in short supply while students are in graduate school. Every day in the United States 37% of the adult population consumes some type of fast food.³³ Time and money are common barriers to healthy eating.³⁴⁻³⁸ Healthy behaviors are often sacrificed when time becomes critical. Our data show that the perception of a healthy diet is positively associated with cooking more meals at home and negatively correlated with lack of time for meal preparation and higher fast-food intake. Male college students tend to eat more frequently at fast-food restaurants or purchase

ready-to-eat foods, often due to time constraints.^{21,38-40} Our results are consistent with recent data from the CDC, which show that younger males were more likely to consume lunch on the go.³³ Linear regression previously showed that food preparation is inversely associated with fast-food consumption.⁴¹ Lack of time often requires quick solutions, hence students often opt for meals eaten out of the home or grab-and-go foods, particularly during the school day.

Most dietary interventions geared toward changing eating behaviors of college students have focused on an educational intervention with measurement of short-term change in fruit and vegetable intake as the primary outcome.⁴² Interestingly, most educational strategies alone or in combination with individualized physical activity interventions fail to show improvements in dietary intake.⁴³⁻⁴⁶ Dining hall interventions, including healthy messaging, food repositioning, or price reduction for healthy foods had little impact on dietary quality.⁴⁷⁻⁵² Use of “traffic-light” labeling at Harvard University to classify the healthiness of dining hall foods did not change dietary intake, although students found the label useful.⁵³ A short cooking intervention also did not influence fruit and vegetable intake.⁵⁴ Personalized interventions using mixed media approaches (email, text messaging, online programs, etc.) had the greatest impact on fruit and vegetable consumption.^{55,56} An online educational intervention focusing on dietary mindfulness and size acceptance continued to significantly influence dietary choices 15 months later.⁵⁶ Therefore, future interventions should focus on the physiological and psychological aspects of eating in order to have a lasting impact in populations of college students.

There were several limitations of this study. One was the self-reported data from the convenience sample of students assessed. All methods of self-reported dietary intake contain considerable bias. Food frequency questionnaires are subject to systematic error, while food diaries or 24-hour food recalls consistently are subject to random error. Use of recovery biomarkers have been utilized in recent years to correct for measurement error.⁵⁷ Another limitation was that students answered the survey based on their individual perceptions of healthy eating, which can vary greatly. A healthy diet to someone who follows the USDA guidelines may vastly differ from someone who follows other, popular fad diets. Additionally, social desirability bias has been shown to influence self-reported dietary recalls, although considerably less bias has been associated with closed-ended food frequency questionnaires compared to open-ended 24-hour food recalls.⁵⁸

CONCLUSION

Students beginning their graduate career are concerned about eating a nutritious diet to prevent disease. They idealize being good role models for their patients, but their dietary practices do not match these values. To further investigate effects of nutrition behaviors and knowledge in chiropractic students, similar assessments should be conducted with the same cohorts later in the program following completion of all nutrition coursework. To improve upon

limitations, future studies should include a definition of a healthy diet and assessment of recovery biomarkers for correction of measurement error inherent with use of intake data. Furthermore, promotion of healthy lifestyle and dietary behaviors needs to become a campus priority.

Chiropractic students at this institution are required to take 150 contact hours of biochemistry and 90 contact hours of nutrition. In comparison, medical schools in the United States and Europe provide an average of 20 contact hours of nutrition education, with less than 25% of medical curricula containing a dedicated nutrition course.^{59–61} Knowledge and application of evidence-based nutrition guidelines could be compared both within and between several healthcare professional students, including medical and chiropractic students, as information in this area is greatly lacking.

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