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ROLE OF CRITICAL NUTRITION LITERACY IN MAKING INFORMED DECISIONS ABOUT DIETARY BEHAVIOR

Janette Nazeli Bedoyan
University of Rhode Island, janettebedoyan@gmail.com

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ROLE OF CRITICAL NUTRITION LITERACY IN MAKING INFORMED
DECISIONS ABOUT DIETARY BEHAVIOR

BY

JANETTE NAZELI BEDOYAN

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

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UNIVERSITY OF RHODE ISLAND

2019

MASTER OF SCIENCE THESIS
OF
JANETTE NAZELI BEDOYAN

APPROVED:

Thesis Committee:

Major Professor Geoffrey W. Greene

Ingrid Lofgren

Sara Sweetman

Nasser H. Zawai
DEAN OF THE GRADUATE SCHOOL

UNIVERSITY OF RHODE ISLAND
2019

ABSTRACT

Statement of the Problem: Nutrition literacy, derived from health literacy, is the ability to understand basic information needed to make appropriate nutrition decisions. Critical nutrition literacy (CNL), the highest level of nutrition literacy, is defined as the ability to critically analyze and apply nutrition information. Although studies have explored the lower levels of nutrition literacy (functional and interactive), CNL has seldom been investigated. One instrument developed to measure CNL, the Critical Nutrition Literacy Tool (CNLT), was found to have strong psychometrical validity and reliability; however, the criterion reliability of the instrument is unknown. Thus, the purpose of this research was to further validate the CNLT in samples of college students in the U.S through three interrelated studies. The aims of this paper are to: examine the relationship between CNL and dietary quality; examine its relationship to a related construct, critical decision making (CDM); and determine if an introductory level nutrition course designed to increase nutrition knowledge will also increase CNL. **Methods:** The methods utilized in this thesis were comprised of three studies. The first study was a secondary data analysis of a cross-sectional survey that examined the relationship between CNL and dietary quality. The second study was a randomized-control trial, using an existing online, problem-based learning program, where the relationship between CNL and CDM scores were evaluated. The third and final study was a secondary data analysis of a non-experimental, pre-post study design of a 4 credit, 13-week, academic course intervention, aimed to determine whether CNL could be increased. Critical nutrition literacy was measured using a validated, 7-item critical nutrition literacy scale. Items were evaluated using a 5-point Likert scale ranging from 1=strongly disagree to 5 =strongly agree.

Critical nutrition literacy scores were then divided into tertiles to produce three equally distributed groups: lower critical nutrition literacy, moderate critical nutrition literacy and higher critical nutrition literacy. **Summary of Results:** This thesis is the first study to explore critical nutrition literacy (CNL), as it is related to dietary quality and critical decision making (CDM), in a diverse sample of college students. There was an overall significant effect of critical nutrition literacy on markers of diet quality, such as cups of fruits and vegetables and teaspoons of added sugars. There was no significant relationship between CNL and CDM score. Finally, a nutrition course designed to increase student knowledge was found to significantly increase CNL score from baseline to post-intervention. Future interventions should focus their attention on developing more sensitive and comprehensive CNL instruments, through experimental designs, to better explore and understand the relationship with eating behavior and CDM.

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PREFACE

This thesis was prepared in manuscript format following the author guidelines for *The Journal of Nutrition Education and Behavior*. After submitting this thesis, the manuscript may be submitted for publication.

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MANUSCRIPT

**“Role of Critical Nutrition Literacy in Making Informed Decisions about Dietary
Behavior”**

By

Janette N. Bedoyan¹

Jade McNamara, PhD²

Ingrid Lofgren PhD, MPH, RD³

Sara Sweetman PhD⁴

Geoffrey Greene PhD, RD, LDN⁵

Prepared for submission to the *Journal of Nutrition Education and Behavior*

¹ Department of Nutrition and Food Sciences, Fogarty Hall, University of Rhode Island, Kingston RI 02881 (jnbedoya@uri.edu)

² Department of Food Science and Nutrition, Hitchner Hall, University of Maine, Orono ME 04469 (jade.mcnamara@maine.edu)

³ Department of Nutrition and Food Sciences, Fogarty Hall, University of Rhode Island, Kingston RI 02881 (ingrid_lofgren@uri.edu)

⁴ School of Education, Chafee Hall, University of Rhode Island, Kingston RI 02881 (sara_sweetman@uri.edu)

⁵ Department of Nutrition and Food Sciences, Fogarty Hall, University of Rhode Island, Kingston RI 02881 (ggreene@uri.edu)

INTRODUCTION

Limited health literacy among adults is a recognized public health problem.¹⁻⁶ Health literacy, the collection of skills necessary for accessing, understanding and processing health information,^{1,2} is essential for making important health decisions and can lead to better health outcomes.⁷⁻¹¹ Although the health literacy field has grown during the past decade, most research does not explicitly focus on food or nutrition.^{12,13} Nutrition literacy, a more specific set of abilities developed by Velardo¹⁴ and derived from Nutbeam's¹ definition of health literacy, is concerned with the ability to understand basic nutrition information and services needed to make appropriate nutrition decisions.^{13,15} Currently, three levels of nutrition literacy have been defined: functional nutrition literacy (applying information to a limited range of activities), interactive nutrition literacy (applying new information to changing circumstances), and critical nutrition literacy (critically analyzing information).^{1,12,13} Validated instruments that measure functional¹⁶ and interactive¹⁷ literacy levels have been established in studies of cancer survivors¹⁸, those with chronic disease¹⁹, and parents of young children.²⁰ However, only two instruments have been developed to measure critical nutrition literacy (CNL).^{21,22}

The two instruments that measure CNL were recently been developed by Naigaga et al.²¹ and Guttersrud et al.²² Naigaga et al.²¹ developed and validated an instrument to measure CNL in 15- to 16-year-old adolescents, known as the critical nutrition literacy evaluation scale (CNL-E).²¹ This survey measured adolescents' perceived level of being able to critically evaluating nutrition information.²¹ However, this instrument was psychometrically validated using a younger sample of adolescents

and does not explore how those with more advanced levels of nutrition education critically evaluate sources of traditional and online media.²¹

The second CNL instrument, the Critical Nutrition Literacy Tool (CNLT), was developed by authors following the sequential method of scale development.²³ It was first psychometrically validated by Guttersrud et al²² in a sample of 473 university nursing students in Norway using item response theory models. This tool was designed with two scales to assess nursing students' social engagement in promoting healthful eating behavior as well as their ability to take a critical stance towards nutrition claims and their sources.^{22,23} The social engagement items are more reflective of Norwegian health activities and thus need modification before testing in a U.S. population. Due to the fact that factor analysis had not yet been performed on the claims scale items, McNamara and colleagues sought to psychometrically validate the 11-item claims scale of the CNLT in a cross-sectional convenience sample of approximately 1,700 U.S. college students (McNamara, oral communication, 2019). Tests for dimensionality were conducted using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).²⁴ Velicer's minimum average partial (MAP) test was used to guide the number of factors to extract.²⁴ Results showed suggested extracting two factors and eliminating four items that did not load on the factors. As a result, a 2-factor, 7-item scale was found to have strong psychometrical validity and reliability; however, the external validity of the instrument is yet to be determined.

After a health construct measure has been proven to be internally consistent and reliable, criterion-related and/or construct validity must be explored.²³ Thus, the purpose of this research was to further validate the revised CNLT, by establishing

criterion reliability, in samples of college students in the U.S through three interrelated studies (See Figure 1). The first study will examine the relationship between CNL and markers of dietary quality to determine if higher CNL is associated with improved dietary quality. Previous research has demonstrated the relationship between functional and interactive levels of nutrition literacy and diet quality.^{25,26} As well, critical health literacy, analogous to CNL, has also been associated with better health outcomes.²⁷ The second study will examine the relationship between CNL and the theoretically related construct of critical thinking operationalized as critical decision making.²⁴ Both constructs require similar skills such as analyzing information, recognizing gaps in evidence and forming logical conclusions using problem solving.^{27,28} Previous interventions have also shown to increase the functional level of nutrition literacy.²⁹ As well, curriculums to increase critical health literacy have been developed.³⁰ Thus, the final study will determine if an introductory level nutrition course designed to increase nutrition knowledge will increase CNL.

METHODS

This research was comprised of three interrelated studies developed in the Nutrition Assessment Laboratory at the University of Rhode Island (URI). The hypothesis of Study 1 is that participants with higher CNL (operationally defined as a scale score in the upper tertile; described below) will consume more cups of fruit and vegetables and less teaspoons of added sugars, as measured by the NCI dietary screener questionnaire, than participants with lower CNL (lowest tertile). The hypothesis of Study 2 is that there will be a significant relationship between CDM score and CNL, controlling for the experimental group (described below). Finally, the

hypothesis of Study 3 is that participants will increase CNL after participation in an Applied General Nutrition course with a laboratory component. Details of the methods are presented by study.

Study 1: To evaluate if CNL is associated with dietary behavior.

The design of Study 1 was an analysis of a cross-sectional study of college students from three different universities: URI, Rutgers and West Virginia University. The Behavior Environment Perception Survey (BEPS) is a survey developed by the Health Campus Research Consortium (HCRC) designed to examine student perceptions of the health of their college environment as well as students' health-related behavior.^{31,32} In Spring 2018, the BEPS survey added the revised CNLT. This survey was administered online and also included dietary assessment and demographics. Among demographic variables, students specified whether they lived on or off campus. For all three universities, living on campus requires a meal plan.

Study 1 Sample. Participants were recruited in the spring of 2018. Recruitment methods varied depending on the university, for example sending out a campus wide link advertising the survey, making classroom announcements, and providing incentives such as extra credit opportunities. Eligibility criteria for this study were: students attending one of the three universities, 18 to 24 years of age, and provided informed consent. All procedures were approved by the Institutional Review Boards at each of the participating universities.

Study 1 Methods:

Dependent Variables. Fruit and vegetable consumption was measured using 10 items from the National Cancer Institute (NCI) Dietary Screener Questionnaire, a

validated and reliable instrument.³³ The 10-items are used to assess the participants' daily fruit and vegetable intakes in cup equivalents based on NCI scoring procedures.³⁴ These 10-items include fruit, fruit juice, salad, fried potatoes, other potatoes, dried beans, other vegetables, tomato sauce, salsa and pizza. Participants were asked to rate the frequency of 100% pure fruit juice consumption, ranging from "Never" to "6 or more times per day". Frequency of consumption of fruit, salad, fried potatoes, other potatoes, dried beans, other vegetables, tomato sauce, salsa and pizza were measured on a scale from "Never" to "2 or more times per day".

Added sugar consumption was measured using eight items from the NCI Dietary Screener.³³ The added sugars variable measured in teaspoon equivalents per day is created by NCI scoring procedures based on the 8-items. These 8 items include soda, fruit drinks, cookies/cakes/pie, doughnuts, ice cream, sugar/honey in coffee/tea, candy, and cereals. Participants were asked to rate the frequency of their consumption of soda, fruit drinks and sugar/honey in coffee/tea, ranging from "Never" to "6 or more times per day". Frequency of consumption of cookies/cakes/pies, doughnuts, ice cream, candy and cereal were measured on a scale from "Never" to "2 or more times per day". Participants selected the type of cereal that they "usually ate" from a provided list.

Independent Variable. Critical nutrition literacy was measured using 7-items from the 11-item CNLT.²² The 7-item scale has recently been further evaluated through an exploratory and confirmatory factor analysis determining reliability and validity of these specific seven items, with loading on two scales (McNamara, oral communication, 2019). Factor 1 consisted of 4 items with loadings ranging from 0.47

to 0.81 ($\alpha = 0.73$) and included questions that explored students' critical appraisal skills when exposed to media sources of nutrition information. Factor 2 consisted of 3 items with loadings ranging from 0.57 to 0.93 ($\alpha = 0.68$) and included questions regarding critical appraisal skills when evaluating information. Items were evaluated using a 5-point Likert scale ranging from 1=strongly disagree to 5 =strongly agree. The responses for each factor were averaged and then combined to produce an overall, average CNL score ranging from 1 to 5. Items were reversed scored for Factor 1 following Guttersrud et al's²² methodology. Critical nutrition literacy scores were then divided into tertiles to produce three equally distributed groups of participants where: a score of 1.0 to 3.21 indicated lower CNL, 3.21 to 3.79 indicated moderate CNL, and 3.79 to 5.0 indicated higher CNL.

Study 1 Analysis. For Study 1, data were analyzed in SPSS 25.0. Any missing responses or selection of "choose not to answer" were excluded from data analysis. Descriptive variables were found to be normally distributed.³⁵ Baseline differences between completers and non-completers and between universities were assessed by chi-square for categorical variables and univariate analysis of variance (ANOVA) for continuous data. To examine the association between the CNL categories and cup equivalents of fruit and vegetable per day and teaspoon equivalents added sugar per day, multivariate analysis of variance (MANOVA) was conducted. ANOVA and post-hoc, Tukey tests were utilized to determine significant differences between CNL tertiles and dependent variables independently.

Study 2: To evaluate if there is a significant relationship between CNL and CDM.

The design of Study 2 was a randomized-control trial in the Fall of 2018. This randomized-control trial used the already existing curriculum developed by McNamara³⁶ that examined the effect of a problem-based learning program on college students' critical decision-making (CDM) skills in evaluating sustainable food choices.³⁶ The experimental group was exposed to a critical thinking framework which introduced the topic in the form of a problem, provided a tool to organize the information, and provided structure for development of a final response. Both groups completed the pre-test, completed two online modules, which used components of problem-based learning and completed the post-test. Subjects were individually randomized into the experimental group with the framework or the comparison group without the framework. The pretest consisted of questions that assessed CNL and demographics. At the beginning of pretests, students selected whether they lived on or off campus.

Study 2 Sample. Participants were recruited in the Fall of 2018 from three introductory level classes. Recruitment was conducted by making classroom announcements and offering extra credit for participation. Eligibility criteria for Study 2 included that participants were current students of the URI at the time, provided informed consent, and were between 18 to 24 years of age. All procedures were approved by the Institutional Review Board at URI.

Study 2 Methods. Critical nutrition literacy was measured using the same validated, 7-item CNL scale as mentioned above.²² In this case, CNL scores were divided into tertiles to produce three equally distributed groups of participants: a score of 1.0 to 3.08 indicated lower CNL, 3.09 to 3.54 indicated moderate CNL, and 3.545

to 5.0 indicated higher CNL. Critical nutrition literacy was assessed in the pretest before module 1 and the posttest following module 2 for all participants.

To calculate the CDM final score, the rubric used by White³⁶ was utilized to score the decision-making activity at the end of Module 2. Scores ranged from 0-30, with a score of 0 indicating: 1) a non-response, or 2) no decision made nor was evidence provided or other point of view seen. A score of 30 indicated a text response that addressed the following: ability to make a decision (10 points); evidence to support the decision (up to 15 points); ability to see the other side's point of view (5 points). The responses were scored using an online survey that guided trained undergraduate research assistants through the response criteria generating a total score. All responses were independently scored by two undergraduate research assistants who completed training.³⁶ Scores that did not match based on the duplicate scores were then independently scored by an expert researcher to determine a final score.

Study 2 Analysis. For Study 2, data were analyzed in SPSS 25.0. Any missing responses or selection of “choose not to answer” were excluded from data analysis. Descriptive variables were found to be normally distributed.³⁵ Baseline differences between CNL tertiles were assessed by chi-square for categorical variables and independent t-tests for continuous data. Analysis of variance tests and correlations were used to determine the association between critical thinking final score and pre-CNL score.

Study 3: To determine if a college-level, introductory nutrition course with a required laboratory component is associated with an increase in CNL.

The design of Study 3 was an analysis of a non-experimental, pre-post study design of a 4 credit, 13-week, academic course intervention in a third sample of college students from URI enrolled in Applied General Nutrition, an introductory level nutrition course. Students consenting to participate in research, completed pre- and post- tests that were administered online and consisted of questions assessing CNL and demographics. All procedures were approved by the Institutional Review Board at URI.

This Applied General Nutrition course, taught by a registered dietitian, aims to increase students' nutrition knowledge with application to the individual, community and beyond. The course is comprised of two, 1¼-hour lectures weekly and weekly 1 hour and 50-minute labs throughout the semester. Students learn basic concepts in lecture and apply these concepts in the hands-on lab. Course content focuses on how nutrients are digested, absorbed, metabolized and utilized as well as how to apply this information to analysis of dietary intake, energy balance and disease prevention. Goals of the course included demonstrating knowledge and understanding regarding 1) the classes of nutrients and their functions and sources, 2) credible and non-credible diet related information, and 3) basic concepts of planning healthy dietary intake, including the U.S. Dietary Guidelines, MyPlate, and food label reading.

Study 3 Sample. Participants were recruited in the Fall of 2018. Recruitment was conducted by making classroom announcements. Eligibility criteria included: participants were students attending URI, 18 to 24 years of age, consented to be included in the study and provided complete data for the CNL scale. All procedures were approved by the Institutional Review Board at the URI.

Study 3 Methods. Critical nutrition literacy was measured using a validated, 5-item preliminary version of the 7-item scale consisting of five items in one factor. Items were evaluated using a 5-point Likert scale ranging from 1=strongly disagree to 5 =strongly agree, for example “I am critical of the dietary information that I receive from various sources in society”. The responses were averaged producing an overall CNL score ranging from 1 to 5, where 1 indicated lower CNL and 5 indicated higher CNL.

Study 3 Analysis. For Study 3, data were analyzed in SPSS 25.0. Any missing responses or selection of “choose not to answer” were excluded from data analysis. Descriptive variables were found to be normally distributed.³⁵ Baseline differences were assessed by chi-square for categorical variables and independent t-tests for continuous data. Repeated measures analysis of variance (ANOVA) was used to assess if students increased their CNL score after completing the course.

RESULTS

Study 1 Results: Relationship with dietary quality.

Although 1,820 students from three universities took the survey, only 1,388 college students provided complete data for demographics, CNL and dependent variables (see Fig 2). Students average reported age was 20.4 ± 1.7 years old, were primarily female (71.9%), white (81.1%) and lived off-campus (61.1%). There was no significant difference between completers and non-completers by age, ethnicity, daily consumption of fruit and vegetables in cup equivalents, or added sugars in teaspoons. As well, there was no significant difference between completers and non-completers by CNL scores.

Comparing by University

Age among URI, Rutgers and WVU students were similar and majority of students at each university were female. A greater proportion of URI and WVU university students were white (77.9% and 84.9% respectively) compared to Rutgers students (44%). Majority of students attending WVU lived off campus (70.3%) compared to URI and Rutgers (51.4% and 50.6% respectively). Fruit and vegetable daily intake was highest among URI students (2.55 ± 1.01), followed by Rutgers (2.36 ± 1.19) and then WVU (2.17 ± 0.96). Furthermore, added sugars was highest in the WVU population (13.09 ± 8.24), followed by URI (12.20 ± 8.46) and then Rutgers (10.82 ± 5.76). There were no significant differences between universities by CNL scores.

Critical Nutrition Literacy

Out of the 1,388 students that completed the survey in full, 459 students (33.1%) were classified with lower CNL 453 (32.6%) with moderate CNL, and 478 (34.4%) with higher CNL according to scoring described in the Methods and listed in Table 3. There was a small, yet significant effect on both living on campus ($F(1,1715) = 29.16, p < 0.001$) and age ($F(6,1434) = 5.78, p < 0.001$) on CNL total score. Those living on campus scored lower than those living off campus (3.46 ± 0.56 versus 3.62 ± 0.62). Those who were younger had lower CNL scores than those who were older (see Table 3).

There was an overall significant effect of CNL tertiles on daily consumption of fruits and vegetables and added sugars ($F(2,1321) = 3.121, p < 0.05$; Wilk's $\Lambda = 0.991$). When examining each dependent variable, students with lower CNL consumed

a greater number of daily teaspoons of added sugar compared to those with higher CNL (1.28 ± 0.53 standard error; $p = 0.043$). Mean added sugar score was 13.54 ± 9.0 (SD) respectively for subjects with lower CNL and 12.27 ± 7.6 (SD) for those with higher CNL. Although no significant relationship was found, there was a trend towards significance where students with lower CNL consumed less cups of fruits and vegetables compared to those with higher CNL (-0.31 ± 0.063 standard error; $p = 0.093$). Mean F/V intake was 2.15 ± 0.89 respectively for subjects with lower CNL and 2.28 ± 0.96 for those with higher CNL.

Study 2 Results: Relationship with CDM score.

Out of 245 college students that participated in the program, a total of 228 students completed the critical thinking program in full and provided complete data for demographics and CNL. Students mean age was 19.42 ± 2.3 years old and were primarily female (81.1%) and white (81.1%). Approximately 65.0% of subjects lived off campus. Reported major was grouped into three categories, following criteria developed by McNamara³⁶. These categories included: Art and Humanities (social sciences, arts and undecided), STEM (science, technology engineering and math) and STEM-Health (nutrition, kinesiology, nursing and pre-medical). Approximately 25% of participants were Arts and Humanities, 21.5% were STEM and 53.5% were STEM-Health majors.

Out of the 228 students that completed the program, 71 students (31.1%) were classified with low CNL, 74 (32.4%) with moderate CNL, and 79 (34.6%) with higher CNL. When controlling for the intervention, there was no significant association between pre-CNL score and critical thinking final score ($F(3,217) = 2.881$, $p = 0.09$).

Study 3 Results: Pre-Post CNL score after completing a nutrition intervention.

Out of the 118 consenting students, 80 students had complete data for CNL and demographics, and were between the ages of 18 and 24. The average age was 18.7 ± 1.1 years old; the majority were white (82%), female (79%), freshmen (61%) and lived on-campus (70%). Participants significantly increased their CNL score from baseline to post intervention from 2.34 ± 0.7 to 2.63 ± 0.7 ($p < 0.01$).

DISCUSSION

The purpose of this research was to externally validate the revised CNLT, through criterion reliability, in samples of U.S. college students through three interrelated studies. When examining CNL's relationship with diet in Study 1, there was an overall effect of CNL on markers of diet quality and those with lower CNL had greater intake of added sugars when compared to those with higher CNL. When exploring CNL in relation to CDM in Study 2, there was no significant relationship between critical thinking score, measured by critical decision-making skills, and CNL. When exploring the changeability of CNL skills in Study 3, it was found that a nutrition course significantly increased CNL from baseline to post-intervention. To the author's knowledge, this is the first study to further explore CNL, through criterion reliability of the revised CLNT instrument, in terms of diet quality, CDM and changeability, in three samples of U.S. college students.

Through validation conducted by McNamara and colleagues, the revised CNL instrument was found to be a reliable and valid measure of select components of CNL. The developed CNL instrument incorporates items that focus specifically on the ability to use appraisal skills to evaluate media sources (Factor 1) as well as to

evaluate evidence-based, nutrition information (Factor 2). It is important to recognize that these items only focus on one component of CNL and do not encompass the other aspects of the construct, which include understanding social determinants of health and engagement in collective action.²⁷ Critical nutrition literacy was developed on the basis that numeracy and basic literacy skills are too narrow to encapsulate the larger collection of social and cognitive skills necessary for individuals to make adequate decisions regarding health.^{13,27,37} When working with the construct of critical health literacy, researchers have developed the term around three distinct components: the critical analysis of information, the ability to understand the social determinants of health, and finally, engagement in social or community action.^{14,27,28} Although the CNL instrument used does not capture the social and engagement domains, it is one of the first of its kind to measure critical analysis of nutrition information. Through the ability to understand and apply scientific nutrition information, individuals will be better prepared to determine differences between evidence-based and non-evidenced based nutrition claims.¹²

There was an overall, significant effect of CNL on markers of diet quality (F/V and added sugar intake). However, when examining these variables independently, the only significant relationship was those with lower CNL had greater intake of added sugars when compared to those with higher CNL. Sugar-sweetened beverages make up almost half of all added sugars consumed by Americans.³⁸ Sugar-sweetened beverages are heavily promoted on college campuses through advertisements and promotional campaigns.^{39,40} The ability to understand diet information is challenging to master and media can have an effect on food and beverage choices.^{21,41} Regardless

of credentials, anyone can relay nutrition information online, putting those who seek it at risk of receiving untrustworthy advice that may lead to adverse effects on health⁴². Knowledge, along with other internal and external factors such as preference, convenience, social influence from peers, and availability in dining halls can influence diet behavior regarding these added sugar products.⁴³ Thus, it is necessary for students to have adequate levels of CNL in order to determine accurate from false claims when addressing health trends related to added sugars.⁴²

Research has shown that higher levels of health literacy are associated with higher levels of critical thinking, decision making and problem-solving skills in adults.^{27,28} However, in this study, there was no significant relationship between critical thinking score, measured by critical decision-making skills, and CNL. The not-statistically significant results may be due to large variability in the final CDM scores or small sample size. Although the scoring system developed to measure CDM in this program was found to have strong interrater reliability and validity, mean scores had large standard deviations for each CNL tertile ($\pm 8.14 - 9.68$). Although other CT instruments have been found to be long and expensive to administer, the use of a more precise and sensitive measure with finer discrimination may have led to significant results.^{44,45} As well, examining CDM in a larger sized sample, such as the sample explored by White³⁶, may have provided the power to see a significant relationship between CDM and CNL.

There was a significant change in CNL score from pre to post intervention in the introductory level nutrition course which aimed to increase nutrition knowledge. Students specifically increased their ability to evaluate media sources after exposure of

the intervention. This reflects other research that has shown the ability of an introductory nutrition course to increase students' food label reading and food choice behaviors.^{29,46} The course in this study was strategically designed with a laboratory component, where the instructor engages the students as much as possible by raising questions, encouraging discussion, and using small group activities to elaborate on ideas in addition to lecturing. Students also received guidance regarding how and where to access information online, which may be seen as a motivating factor for students to seek more accurate, high-quality information.^{47–50} Future introductory nutrition classes should highlight the ability to critically analyze nutrition information, through determining its credibility, and how to use this information to improve dietary choices.

Strengths and Limitations

This study is the first to establish criterion reliability for the revised CNLT. As well, this study consisted of a unique study design using validated instruments and a relatively large sample size. However, it is important to recognize the limitations of the study. This sample focused on exploring one component of CNL in a predominately female, white, college student sample. It is important to note that when measuring CNL, other environmental factors, such as culture, food availability and access, transportation and access to technology were not assessed. Measures of CNL were self-reported, and some students may overrate their abilities when it comes to finding and interpreting information online. In terms of F/V and added sugar intake, these components only make up certain markers of diet quality and do not capture overall diet behavior in college students. Fruit and vegetable intake and less added

sugars are only a few components of a healthy diet, but do not to account for a complete measure of diet quality. Other studies that utilized a measure of diet quality when determining its relationship with NL have used instruments such as the Healthy Eating Index, which includes 12 components of diet.^{49,50} College students' diets are low in F/V yet high in added sugars; however, other components of the diet are necessary to examine as two food groups are not encompassing of a typical diet. By including a more comprehensive measurement of diet quality, there may be an opportunity to discover a greater relationship between CNL and diet quality.

Conclusions/Applications

Future studies should further explore CNL by examining more comprehensive and sensitive measures that go beyond the critical analysis of nutrition information, such as identifying social determinants of health and engagement in social or community action. It will also be important to explore other potential mediating and moderating factors that may play a role in CNL's relationship to diet quality, such as demographic variables, social support and self-efficacy, to help describe their influence on nutrition behavior outcomes. Finally, due to the fact that cross-sectional studies were used to determine correlations between CNL and F/V and added sugar intake as well as CDM, causal relationships were unable to be determined and are thus necessary to explore in future research.

The revised CNLT can be utilized for outcome evaluations of other nutrition interventions that aim to increase the ability to understand and apply nutrition information. Application of this tool to other populations who may be more vulnerable to influences from the media is needed. However, psychometric validation will be

necessary before implementation in these groups. When considering populations beyond college students, specifically those in diverse groups, it will be important to consider how these individuals develop skills and make use of nutrition resources. Finally, nutrition information is delivered and received through other means in addition to media, such as through society.²¹ Researchers should thus continue to evaluate CNL and assess the relationship it has with other criteria in various settings.

TABLES

Table 1: Study 1 Baseline Characteristics by Completers versus Non-Completers

Continuous Variables		Completers n=1388 (mean ± sd)	Non-Completers n=432 (mean ± sd)	t
Age		20.35 ±1.69	20.19 ±1.41	-1.09
Critical Nutrition Literacy Score		3.54 ±0.60	3.66 ±0.62	2.03
Added sugars (tsp)/day		12.85 ±8.14	11.37 ±6.29	-0.42
F/V cup equivalents (legumes and FF included)		2.23 ±0.97	2.15 ±0.84	-0.26
Categorical Variables		Completers n (%)	Non-Completers n (%)	Chi-Square
Gender	Female	n= 1388 1009 (72.7)	n= 422 258 (61.1)	20.68**
	Male	379 (27.3)	164 (38.9)	
Ethnicity	White	n= 1382 1123 (81.3)	n= 428 328 (76.6)	10.48
	Hispanic/Latino	65 (4.7)	17 (4.0)	
	Black/AA	61 (4.4)	22 (5.2)	
	Asian/Pacific/NA	83 (6.0)	39 (9.2)	
	Other	50 (3.6)	22 (5.1)	
University	URI	n= 1387 116 (8.4)	n= 430 17 (4.0)	39.10**
	Rutgers	171 (12.3)	16 (3.7)	
	WVU	1100 (79.3)	397 (92.3)	
Live On or Off Campus	On	n= 1380 540 (39.1)	n= 426 58 (13.6)	95.69**
	Off	840 (60.9)	358 (84.0)	

****p<.01**

Table 2: Study 1 Baseline Characteristics by University

Continuous Variables		URI n=115 (mean ± sd)	Rutgers n=165 (mean ± sd)	WVU n=1075 (mean ± sd)	F-test
Age		20.1 ±1.4	20.2 ±1.5	20.4 ±1.7	1.68
Critical Nutrition Literacy Score		3.61 ±0.67	3.61 ±0.54	3.56 ±0.61	1.04
Added sugars (tsp)/day		12.20 ±8.46	10.82 ±5.76	13.09 ±8.24	6.35*
F/V cup equivalents (legumes and FF included)		2.55 ±1.01	2.36 ±1.19	2.17 ±0.96	11.19**
Categorical Variables		URI n (%)	Rutgers n (%)	WVU n (%)	Chi-Square
Gender	Female	79 (68.6)	126 (76.3)	736 (68.5)	4.06
	Male	36 (31.4)	39 (23.8)	339 (31.5)	
Ethnicity	White	90 (77.9)	75 (45.6)	913 (84.9)	153.0**
	Hispanic/Latino	9 (7.7)	24 (14.4)	32 (3.0)	
	Black/AA	8 (6.7)	19 (11.3)	35 (3.3)	
	Asian/Pacific/NA	5 (4.8)	34 (20.6)	58 (5.4)	
	Other	3 (2.9)	13 (8.1)	37 (3.4)	
Live On or Off Campus	On	56 (48.6)	82 (49.4)	319 (29.7)	37.2**
	Off	59 (51.4)	83 (50.6)	756 (70.3)	

* **p<.05**

****p<.001**

Table 3: Study 1 Relationship between Baseline Demographics and Critical Nutrition Literacy Tertiles

Continuous Variables		Lower CNL mean $\pm$ sd	Moderate CNL mean $\pm$ sd	Higher CNL mean $\pm$ sd	F-test
Age		20.2 $\pm$ 1.58	20.2 $\pm$ 1.67	20.65 $\pm$ 1.73	12.18**
Categorical Variables		Lower CNL (%)	Moderate CNL (%)	Higher CNL (%)	Chi-Square
Gender	Female	68.4	70.5	70.6	0.76
	Male	31.6	29.5	29.4	
Ethnicity	White	76.7	79.6	84.4	17.00
	Hispanic/Latino	4.7	4.3	4.7	
	Black/AA	5.8	4.3	3.6	
	Asian/Pacific/NA	7.8	8.1	4.6	
	Other	4.9	3.6	3.1	
Live On or Off Campus	On	38.3	36.3	26.3	22.07*
	Off	75.5	63.7	73.7	

Tertiles divided: 1.0-3.21 = lower, 3.2101-3.79 = moderate, 3.7901-5.0 = higher

***p<0.05**

****p<0.01**

Table 4: Study 1 Relationship between Critical Nutrition Literacy Tertiles and Dependent Variables (Fruits and Vegetables and Added Sugars)

DSQ Wilk's $\Lambda = 0.991$	Lower CNL (n=459) mean $\pm$ sd	Moderate CNL (n=453) mean $\pm$ sd	Higher CNL (n=478) mean $\pm$ sd	F-test
Added sugars (tsp)/day	13.54 $\pm$ 9.0	12.76 $\pm$ 7.8	12.25 $\pm$ 7.6	3.121*
F/V cup equivalents	2.15 $\pm$ 0.89	2.26 $\pm$ 1.1	2.29 $\pm$ 0.97	

Tertiles divided: 1.0-3.21 = lower, 3.2101-3.79 = moderate, 3.7901-5.0 = higher

* **p<.05**

Table 5: Study 2 Baseline Characteristics and Critical Thinking Final Score by Critical Nutrition Literacy Tertiles

Continuous Variables (mean ± sd)		Lower CNL (n=71) mean ± sd	Moderate CNL (n=74) mean ± sd	Higher CNL (n=79) mean ± sd	F-test
Age		19.14 ±1.49	19.26 ±1.86	19.87 ±3.11	0.298
Critical Thinking Final Score		17.75 ±8.14	14.59 ±9.68	18.29 ±8.88	1.15 ^a
Categorical Variables		Lower CNL (%)	Moderate CNL (%)	Higher CNL (%)	Chi Square
Gender	Female	81.7	74.3	88.6	5.21
	Male	18.3	25.7	11.4	
Ethnicity	White	78.9	81.1	82.3	7.81
	Hispanic/Latino	5.6	8.1	10.1	
	Black/AA	5.6	5.4	3.8	
	Asian/Pacific/NA	0.0	0.0	1.3	
	Other	7.0	2.7	1.3	
		1.4	0.0	1.3	
Live On or Off Campus	On	69.0	70.3	53.2	8.51
	Off	31.0	29.7	46.8	
Major	A-H	26.8	25.7	22.8	4.52
	STEM	22.5	27.0	15.2	
	STEM-H	50.7	47.3	62.0	

Tertiles divided: 1.0-3.08 = lower, 3.0801-3.54 = moderate, 3.5401-5.0 = higher

^ap = 0.09

Table 6: Study 3 Baseline Characteristics

Continuous Variables (mean $\pm$ sd)		n=92	t value
Age		18.73 $\pm$ 1.06	2.17*
Categorical Variables n (%)		(%)	Chi Square
Gender	Female	79.3	90.5*
	Male	20.7	
Ethnicity	White	81.5	75.2*
	Black/AA	3.3	
	Hispanic/Latino	7.6	
	Asian	2.2	
	Mixed	3.3	
	Other	2.2	
Live On or Off Campus	On	70.0	14.4*
	Off	30.0	
Meal Plan	Yes	74.7	22.2*
	No	25.3	

***p < 0.001**

Table 7: Study 3 Change in Critical Nutrition Literacy for Participants with Completed Data

Variable	Baseline (mean $\pm$ sd)	Post-Intervention (mean $\pm$ sd)	T-test
Critical Nutrition Literacy	2.34 $\pm$ 0.65	2.63 $\pm$ 0.72	-3.56*

***p<0.01**

FIGURES

Figure 1: Conceptual Map

Figure 2: Study 1 Sample Size Flow Chart

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APPENDICES

A. LITERATURE REVIEW

Introduction

Nutrition literacy, derived from health literacy, is the ability to understand basic information needed to make appropriate nutrition decisions.¹ Critical nutrition literacy (CNL), the highest level of nutrition literacy, is defined as the ability to critically analyze and apply nutrition information, using more advanced critical appraisal skills.^{1,2} Although studies have explored the lower levels of nutrition literacy (functional and interactive), CNL has only been investigated in two studies with recently developed survey instruments.^{3,4} The purpose of this literature review is to describe the research that has been conducted on health and nutrition literacy and the instruments developed to measure these abilities. As well, this review aims to explore constructs related to CNL in college students, including dietary quality, critical decision making, and knowledge, that have been previously explored in health and nutrition literacy.

I. Health Literacy

Health literacy, the collection of skills necessary for accessing, understanding and processing health information,^{5,6} plays an important role in understanding the relationships between knowledge, decisions and health outcomes.⁷⁻¹³ Health literacy is defined as a public health objective by Healthy People 2020,⁵ with a goal of using “health communication strategies and health technology to improve population health outcomes and health care quality”.⁶ This objective discusses how the effective use of communication and technology by health care and public health professionals allows

for positive impacts on health, specifically increasing health literacy skills.⁶ With the increasing complexity of health information, the majority of people may need additional information, knowledge and skills to understand their health needs.^{5,6} It has been found that limited health literacy is related to decreased health knowledge, health status and use of health services.⁶⁻¹⁰ More specifically, limited health literacy has been associated with poor self-management of chronic diseases and conditions, increased hospital visits as well as suboptimal comprehension of nutrition labels, prescription medication instructions, and medical instructions in general.¹⁰

Health literacy has been proven to be a stronger indicator of health than age, employment status, income, education level and race.⁷⁻¹³ In a study involving low-level readers enrolled in adult basic education classes, subjects with the lowest reading skills had poorer physical and psychological health than those with better reading skills.⁷ Similarly, a study of 2,659 patients at two public hospitals found that those with inadequate health literacy were more than twice as likely to have poor self-reported health status compared to subjects with adequate health literacy.⁸ Another recent study found that low literacy was a better predictor than race or age of metastatic disease at presentation diagnosis of prostate cancer.¹⁰

It can be concluded that health literacy plays a vital role in indicating health status. When exploring how health literacy leads to certain health outcomes, it is important to acknowledge the different levels of health literacy.

Levels of Health Literacy

Nutbeam⁵ provides a public health approach to literacy that can be used to map the expansion of health literacy levels beyond the level of basic health knowledge.

Nutbeam highlights the importance of achieving health literacy at three distinct levels: functional, interactive, and critical.⁵ At the simplest level, functional health literacy is concerned with the use of general literacy skills, such as reading, writing, and understanding basic health messages.⁵ Development of knowledge is limited at this level, and such actions will result in individual benefit, rather than towards population benefit.⁵ By contrast, interactive health literacy focuses on the ability to understand and use information for prevention and self-management, while at the same time, develop personal skills.⁵ At the interactive level, people are able to apply new information to changing circumstances both confidently and independently.⁵ Much of these actions however, similar to functional health literacy, will result in individual benefit, rather than population benefit.⁵ In discussing the highest level, (critical health literacy) Nutbeam⁵ emphasizes the importance of being able to critically analyze information using more advanced cognitive and social skills, and to use this information to exert greater control over life situations. Nutbeam⁵ frames critical health literacy as a social capacity, in addition to individual. Improved capacity to act on social determinants of health can, in turn, lead to improved community empowerment.⁵

It is important to understand the different levels of health literacy and how they are presented as an ordinal scale. Validated and reliable instruments have been developed to measure health literacy and aim to capture peoples' abilities as the functional and interactive levels.

Measuring Health Literacy

Since the 1990s, health literacy has been primarily measured through reading and writing skills of individuals in the clinical or health care setting.¹⁴ Instruments such as the Test of Functional Health Literacy in Adults (TOFHLA),¹⁵ the Rapid Estimate of Adult Literacy (REALM) in Medicine¹⁶ and the Critical Health Competence test (CHC Test)¹⁷ have been validated and are reliable instruments that measure health literacy.

The TOFHLA is a valid, reliable indicator of patient ability to read health-related materials.¹⁵ The Test of Functional Health Literacy in Adults (TOFHLA) was developed using actual hospital materials and consists of a 50-item reading comprehension and 17-item numerical ability test, taking up to 22 minutes to administer.¹⁵ 256 English- and 249 Spanish-speaking patients were approached.¹⁵ It was suggested that a high proportion of patients cannot perform basic reading tasks, 15% of the patients could not read and interpret a prescription bottle with instructions, 37% did not understand instructions to take a medication on an empty stomach, and 48% could not determine whether they were eligible for free care.¹⁵

The Rapid Estimate of Adult Literacy in Medicine (REALM) was developed as a quick screening tool to assist physicians in identifying patients with limited reading skills and in estimating patient reading levels.¹⁶ The instrument was used to test reading ability in 207 adults in six public and private primary care clinics.¹⁶ The REALM, which takes three to five minutes to administer and score, appears to be a practical instrument to estimate patient literacy in primary care, patient education, and medical research.¹⁶

The Critical Health Competence Test (CHC Test) was developed and validated to measure critical health competences.¹⁷ The testing of the 72-item questionnaire was completed in three phases in secondary school and university students.¹⁷ During the first phase, the questionnaire was pre-tested by collecting qualitative data from eight students through interviews focused on the students' understanding of the items.¹⁷ The second phase involved applying the Rasch model to assess the appropriateness of the surface level design of the questionnaire.¹⁷ Finally, a second field test was conducted as a part of the third phase, where it was concluded that the Rasch model was the best fitting model for the instrument.¹⁷ Reliability of the instrument was found to be 0.9. Thus, the authors concluded that this questionnaire was a feasible, valid, and reliable instrument to measure the construct of critical health literacy.¹⁷

These instruments have helped reduce respondent burden by being less time consuming to administer and taxing for respondents to complete. As well, they are valid and reliable tools that measure the three levels of health literacy. However, they do not focus on nutrition specifically. Thus, research is needed to explore nutrition literacy and develop measurements to assess it.

II. Nutrition Literacy

Although the field has grown during the past decade, most health literacy research does not explicitly focus on food or nutrition.^{1,11} Authors conceptualize nutrition literacy as a specific domain under the broader construct of health literacy that reflects the ability to access, interpret, and use nutrition information.^{1,11} Nutrition literacy defined by Velardo,¹ as mirrored by Nutbeam's definition of health literacy,⁵ is concerned with the ability to understand nutrition information and to use that

information to make appropriate nutrition decisions. Nutrition literacy has also been developed along the same three levels as health literacy, (functional nutrition literacy, interactive nutrition literacy and critical nutrition literacy) with each level of nutrition literacy resulting in different nutrition-related outcomes.^{5,6,11,13,19,20} Functional nutrition literacy is the ability to utilize basic literacy skills, such as numeracy and reading; interactive literacy is more concerned with applying new information to changing circumstances; critical nutrition literacy is the ability to critically analyzing information.^{1,5,11} These three different levels of nutrition literacy are structured on an increasing scale, where a critical nutrition literacy is associated with an increased ability to critically analyze information, determine credibility and truth, challenge sociocultural norms related to nutrition and take action to address barriers.^{1,21}

Similar to health literacy, instruments have been developed to measure to nutrition literacy at each level. The developed measurement tool, results and limitations are draw out in the figure below and further described in the following sections.

Functional Nutrition Literacy					
Author, year	Study Design	Participants	Measurement tool	Results	Limitations
Weiss, 2005	Validity testing	500 participants from 3 primary care practices in Arizona	Newest Vital sign (NVS) – 6 items + Nutrition label	Reliable (Cronbach α >0.76 in English and 0.69 in Spanish) Patients with more than 4 correct responses are unlikely to have low literacy, whereas fewer than 4 correct answers indicate the possibility of limited literacy.	Solely measures reading and interpretation skills as applied to material with health content, not diverse
Zoellner, 2011	Cross-sectional: HEI and NL	376 adults in rural Lower Mississippi Delta	Newest Vital sign (NVS) - 6 items + Nutrition label	Every 1-point increase in health literacy was associated with a	Causality cannot be inferred, HEI based on 24-

			and 158-item FFQ	1.21-point increase in HEI scores. Health literacy also significantly predicted SSB consumption ($R(2)=0.15$; $F=6.3$; $P<0.01$).	hour recall, did not account for other factors such as availability of grocery stores, high nutrient dense foods and transportation
Huizinga, 2008	Validity testing	398 Diabetes patients	Diabetes Numeracy Test (DNT) – 43 items, DNT-15 (shortened 15-item version)	Exceptional internal reliability ($KR-20 = 0.95$). Significantly correlated ($p < 0.05$) with education, income, and diabetes knowledge. The mean score on the DNT was 61% and took an average of 33 minutes to complete.	No input from patients, primarily focuses on numeracy, with some focus on nutrition care, in relation to one disease state
Interactive Nutrition Literacy					
Author, year	Study Design	Participants	Measurement tool	Results	Limitations
Gibbs, 2013	Validity testing	134 dietitians	Nutrition Literacy Assessment Instrument (NLAI) – 6 items	Good agreement was found for all items (89.7%)	Only tested on elderly AA population, solely focuses on food label and numeracy, household food measurement, food groups, energy sources in food and consumer skills
Gibbs, 2017	Cross-sectional	429 adults with chronic disease	Nutrition Literacy Assessment Instrument (NLit) – 6 subscales and HEI-2010 (Diet History Questionnaire II)	Nutrition literacy was the most significant predictor of diet quality. Strong relationship found between nutrition literacy scores and diet quality scores (HEI-2010).	Diet quality measured using FFQ, those with low health literacy may struggle to report accurate portion intake, diet quality higher in this sample compared to general population
Gibbs, 2016	Cross-sectional: NL of Parents and relationship	101 parent-child dyads	Nutrition Literacy Assessment – Parent (NLit-P)	For every 1% increase in NLit-P, there	Already high nutrition literacy score, not diverse,

	with child diet quality			was a 0.51 increase in child HEI multivariate coefficient, 0.174; $P < .001$	cross-sectional study
Gibbs, 2017	Pilot testing	17 high-risk women and 55 breast cancer survivors	Nutrition Literacy Assessment – Breast Cancer (NLit-BCa)	Significant relationships were found between five of the six domains of nutrition literacy and diet quality ($P < 0.05$).	Already high nutrition literacy score, not powered, not diverse
Critical Nutrition Literacy					
Author, year	Study Design	Participants	Measurement tool	Results	Limitations
Guttersrud, 2014	Validity testing	473 nursing students in Norway	Critical Nutrition Literacy claims (11 items) and engagement (8 items) scales	Reliable tool, showed promising validity	Small sample, not conducted in the U.S.
Naigaga, 2018	Validity testing	1622 students aged 15-16 years old	Critical Nutrition Literacy scale (CNL-E) – 5 items	A valid, reliable and well-targeted scale with good overall fit. All items were sufficiently statistically independent.	Only tested on one sample, items limited to “traditional” media and online media sources

Functional Nutrition Literacy

At a basic or functional level, nutrition literacy skills should encompass the ability to obtain factual dietary information and develop an understanding of factors that can enhance good health.^{15,16,22} Literacy at this level should encompass the ability to identify foods that are high in sugar or fat, or to understand the health benefits of dietary fiber.¹⁶ The outcomes of this level of nutrition literacy include improved knowledge of health risks, components of a healthy diet, and the benefits of good nutrition.^{15,16,22}

The Newest Vital Sign was developed as a quick and accurate screening test for functional literacy available to English-speaking and Spanish-speaking primary

care patients. The Newest Vital Sign (NVS), was developed from a series of scenarios.²² Patients were given health-related information, in which the patients read and then demonstrated their ability to use the information by answering questions about the scenarios.²² The questions were scored as either correct or incorrect according to a scoring key provided to the interviewers. Patients with more than 4 correct responses are unlikely to have low literacy, whereas fewer than 4 correct answers indicate the possibility of limited literacy.²² Using this test can alert physicians to patients who may need more attention and help physicians focus on physician-patient communication using recommended procedures.²²

Similar to the TOFHLA and REALM, instruments developed to measure functional health literacy, the NVS solely measures reading and interpretation skills as applied to material with health content, rather than all aspects of nutrition literacy.^{1,20}

Interactive Nutrition Literacy

Interactive literacy encompasses the ability to apply new information to changing circumstances and is comprised of more advanced cognitive and interpersonal communication skills used to improve one's nutritional status and behavior.^{15,16,22} Interactive nutrition literacy reflects the ability to translate declarative knowledge into positive dietary choices.^{15,16,22} For example, knowing that too much sugar is problematic and then identifying a product low in sugar would qualify as using interactive nutrition literacy skills.²² The interactive level is also comprised of the development of more complex skills, motivation, and confidence needed to navigate nutrition research.²²

The Nutrition Literacy Assessment Instrument (NLAI) is a content-valid measure of interactive nutrition literacy that was developed for a pilot study conducted among 26 clients.²³ Items used in the NLAI consisted of nutrition and health categories such as macronutrients, household food measurement, food label and numeracy, and food groups.²³ The nutrition literacy score from the NLAI was then compared to the REALM. The correlation between the REALM and NLAI, however, was not significant ($r = 0.38$; $p = .06$). The NLAI was valid as tested within this study, and 134 registered dietitians completed a survey in regards to the relevance of items used in the instrument.²³

Although the dietitians preferred the NLAI over the REALM, they also believed nutrition literacy requires skills and knowledge beyond the ability to read food labels.²³ Thus, the need to move beyond a functional and interactive understanding of nutrition literacy is evident; yet, how this might look or how it could be measured requires further investigation.²³

Critical Nutrition Literacy

There has been little attention paid to establishing valid instruments for measuring critical nutrition literacy. Critical nutrition literacy is the ability to critically analyze information and use this information to exert greater control over life events and situations and is the highest level of nutrition literacy.^{1,11,21} Forming connections between nutrition, health, and society by considering the greater impacts of one's food choices is an extremely significant part of critical nutrition literacy.^{1,11,21} This could further encompass decision making that reflects moral and ethical values and result in advocating for change to nutrition policies and practices. When working with the

construct of critical health literacy, authors have developed the term around three distinct components: the critical analysis of information, the ability to understand the social determinants of health, and finally, engagement in social action.^{1,2}

Critical nutrition literacy has only been examined by two recently developed instruments. Naigaga³ developed and validated an instrument to measure critical nutrition literacy in adolescents, known as the critical nutrition literacy scale (CNL-E). This survey captured adolescents' perceived difficulty level of critically evaluating nutrition information.³ However, this instrument was psychometrically validated using a sample of adolescents and does not capture how sources of information other than traditional and online media are critically evaluated.³ As well, it does not explore how those with advanced levels of nutrition education critically evaluate sources of traditional and online media.³ The second CNL instrument, the Critical Nutrition Literacy Tool (CNLT) assessed nursing students' engagement in dietary habits as well as their level of taking a critical stance towards nutrition claims and their sources and was developed by Guttersrud et al.⁴ The CNLT was scored on a 5-point Likert scale and administered to 473 university students in Norway to test for validity.⁴ The items used to measure social engagement are more reflective of community abilities and thus need modification before testing in a population living in a more restricted environment.

As a result, the psychometric structure of the claims scale of Guttersrud's CNLT was validated by McNamara (personal communication, 2019) in a cross-sectional convenience sample of 1,718 U.S. college students. Tests for dimensionality were conducted using exploratory factor analysis (EFA) and confirmatory factor

analysis (CFA). Velicer's minimum average partial (MAP) test was used to guide the number of factors to extract. Results showed that the MAP test suggested extracting two factors. All factor loadings were significant based on z -test results. As a result, a 2-factor, 7-item scale, known as the revised CNLT, was found to have strong psychometrical validity and reliability.

Factor 1, consisting of items relating to confidence, influence and referral of/to media sources, may be seen as more concerned with the construct of media literacy. College students today are exposed to nutrition information from various sources, with a greater emphasis of those sources being online, such as websites, blogs and social media platforms.²³ While the access to this type of information is now easier than ever, there has also been an increase in confusion when it comes to how to analyze these sources.²³ The use of appraisal skills to interpret, make judgements and evaluate information is thus the definition of media literacy.^{24,25} Authors suggest that in order for individuals to become media literate, they must be able to find meaning in the information produced by the media source and further have the ability to "construct" that meaning for themselves.^{24,25} However, it is not necessarily the case that an increased ability to do this will result in behavior change. According to other education research, students may have the knowledge to perform certain behaviors; however, they may not have the capacity to implement it.²⁶

Factor 2, on the other hand, consists of items relating to the ability of understanding diet information. Being able to understand diet information is challenging. Regardless of credentials, anyone can broadcast nutrition information online, putting those who seek it at risk of receiving untrustworthy and oftentimes,

advice that is detrimental to their health.^{3,27} The Factor 2 specifically touches on how students may criticize diet information as well as whether they base their diet on information from scientifically recognized literature. It has been found that increased knowledge and understanding of dietary guidance appears to be positively related to more healthful eating patterns.^{28,29} In order to see a more significant relationship between these constructs, nutrition professionals in the media work must together to produce a set of clear, consistent, and evidence-based messages that address up and coming health trends, so recommendations for a healthful diet can be recognized more quickly and put into practice.²⁷

Nutrition Literacy and Dietary Quality

Research has shown that an increase in nutrition literacy is associated with positive health outcomes. However, research on diet quality in relation to CNL is limited. One study has examined the relationship between functional nutrition literacy and dietary quality.¹² This cross-sectional study examined nutrition literacy skills in relation to Healthy Eating Index scores (HEI) and Sugar-Sweetened Beverage (SSB) consumption in a community-based sample of adults (n=376) in the rural Lower Mississippi Delta.³⁰ Instruments for the study included a validated 158-item regional food frequency questionnaire as well as the Newest Vital Sign. Approximately 195 (51.8%) participants were classified with a high likelihood of limited literacy skills, 83 (22.1%) with a possibility of limited literacy skills, and 98 (26.0%) with adequate literacy skills.³⁰ Total HEI scores varied by nutrition literacy category, such that respondents with adequate health literacy skills scored approximately four points higher than those with high likelihood of or possibility of limited health literacy.³⁰ For

SSB, participants in the lowest health literacy category consumed about 119 kilocalories/day more than those with adequate health literacy.³⁰ In terms of prediction, every additional 1 point on the health literacy scores was associated with 1.21 points in healthy eating index scores ($p < 0.01$), while controlling for all other variables.³⁰ Although this study was successful in determining a relationship between nutrition literacy and diet quality, this study did not go beyond measurement of nutrition facts label and future interventions are necessary to explore higher ordered levels of nutrition literacy.

Authors have also examined the relationship between nutrition literacy and dietary quality, but specifically explored the interactive level in breast cancer patients³¹, parents³², and adults with chronic disease³³ with the Nutrition Literacy Assessment Instrument (NLAI or NLit). In 2016, Gibbs et al³¹ developed the NLit-BCa and tested its validity and reliability in a sample of 17 high-risk women and 55 breast cancer survivors. Construct validity was evaluated by comparing results of the NLit-BCa to Healthy Eating Index scores derived from two separate 24-hour dietary recalls and was acceptable (0.93).³¹ Reliability for three domains of the NLit-BCa was found to be substantial (> 0.80).³¹ General linear modeling of the relationships between nutrition literacy (as measured by the NLit-BCa) and diet quality (as measured by HEI-2010) demonstrated a significant positive relationship ($p < 0.05$) between five domains of the NLit-BCa and HEI-2010, including Macronutrients, Household Food Measurement, Food Label and Numeracy, Food Groups, and Consumer Skills.³¹ However, participants initially had high nutrition literacy scores, eluding to the fact that this sample was not diverse and could not be generalized to the

entire U.S. population. As well, the instrument focused on only one level of nutrition literacy and failed to explore it at a critical level.

Gibbs et al³² also assessed interactive nutrition literacy in parents and its relationship with child diet quality. This cross-sectional study of 101 parent-child dyads utilized 2, 24-hour diet recalls to measure diet quality and the NLit-P to measure nutrition literacy.³² It was found that for every 1% increase in NLit-P, there was a 0.51 increase in child HEI ($R^2=0.174$; $p<0.001$).³² Although this instrument demonstrated potential for measuring nutrition literacy in parents, participants had already high nutrition literacy scores and the sample was not diverse.

When examining interactive nutrition literacy and diet quality in adults with chronic disease, Gibbs et al³³ utilized the NLit and nutrient data from Diet History Questionnaire II surveys for Healthy Eating Index measures. A sample of 429 adults were recruited from clinics affiliated with A Midwestern university medical center.³³ The NLit demonstrated substantial factor validity and reliability (0.97; confidence interval, 0.96– 0.98).³³ Nutrition literacy was also found to be the most significant predictor of diet quality (multivariate coefficient = 0.10; $p < .001$)³³. In terms of diet quality, a strong relationship was found between nutrition literacy scores and diet quality scores (HEI-2010).³³ Although the NLit is a promising valid and reliable tool for measuring NL in adult primary care patients, it does not encompass higher skills that contribute to critical nutrition literacy and diet quality among participants was initially already high compared to the general population.

It is clear that diet quality has been associated with lower levels of nutrition literacy: the functional and interactive levels. However, the relationship between diet

quality and CNL, the highest level of nutrition literacy, remains unknown. Examining the diet quality of a specific population, such as college students, is important when determining whether this relationship exists.

III. Dietary Quality in College Students

College students are living away from home for the first time and thus experience increased independence in daily food choices as well as health behavior.^{29,34,35} Studies have found that college students engage in unhealthy eating behaviors, such as skipping meals, fast food consumption and high energy dense snacking, leading to a decreased consumption of fruits and vegetables and a greater consumption of sugar.^{29,34,35} A diet comprised of low intakes of fruits and vegetables and high intakes of sugar can result in several negative health outcomes later in adulthood, especially overweight and obesity.³⁶ The importance of consuming more fruits and vegetables and less sugars is significant, as such behaviors along with other healthy lifestyle modifications, can result in decreased risk for chronic disease.^{34,36,37}

In U.S. universities, only 5.5% of college students meet the Dietary Guidelines recommendations for fruit and vegetable intake,³⁸ with average consumption of 1 serving of fruit and 1.5 servings of vegetables daily.³⁹ American College Health Association – National College Health Assessment (ACHA-NCHA) data indicate that only 7.3% of college students consume 5 or more daily servings of fruits and vegetables.⁴⁰ Other studies have shown that the typical college student's diet is high in fat, sugar, and sodium and lacking in nutrients essential for their health.³⁹ Added sugars account for approximately 270 calories or 13% of calories per day in the American diet.⁴¹ Young women between the ages of 18 and 24 consume

approximately 15.1 teaspoons of added sugar per day, while young men between the ages of 18 to 24 consume approximately 23.9 teaspoons of added sugar per day.⁴² It is evident that consumption of added sugars in this population falls above the recommended 10% of calories in the Dietary Guidelines.⁴¹ It is important to examine consumption of foods among these students that have much variance from the recommendations by 2015-2020 Dietary Guidelines.⁴¹

IV. Critical Decision Making

In order to further understand critical nutrition literacy, it is important to discuss its relationship to and similarities with critical thinking. One specific aspect of critical thinking involves critical decision making, the ability to analyze information, recognize gaps in evidence and form logical conclusions using problem solving.⁴³ The ability to critically analyze information and determine credibly and truth are two constructs that are a part of the critical nutrition literacy definition.^{1,21,43} These critical thinking skills should be encouraged so that students have a natural inclination to consider facts, recognize gaps within the evidence, and evaluate all choices when making decisions about health.⁴³ Research has shown that higher levels of health literacy are associated with higher levels of critical thinking, decision making and problem-solving skills.^{21,44-49} However, to the author's knowledge, there has been no research that explores the relationship between CNL and critical decision making. Being able to explore this relationship requires a discussion of the instruments developed to measure critical thinking and critical decision-making skills.

Critical Thinking Assessment

Numerous tools have been developed to measure critical thinking, some of which include the Cornell Critical Thinking Test, the California Critical Thinking Skills Test and the Critical Thinking Assessment Tool (CAT).⁵⁰ These tools have all been validated to measure critical thinking; however, they require long periods of time to complete, which may hinder the use of these tools in a college lecture or section.^{51,52} However, with further research and analysis, majority of the critical thinking instruments have found to be inconsistent in terms of validity and reliability^{50,52} and may not be sensitive enough to measure indicators of the use of critical thinking in specific courses. Thus, when developing tools, it is important to consider what aspect of critical thinking one is measuring.

A randomized control trial conducted through the Nutrition Assessment Lab at the University of Rhode Island incorporated problem-based learning into an online, educational program for college-aged students that focused on decision making around sustainable food choices.^{53,54} This study was designed to measure and facilitate critical decision making (CDM) in students who were enrolled in large introductory level classes.⁵³ Students were randomized into either a CDM-framework (CDM-F) group or a control group.⁵³ Both groups were exposed to critical thinking videos that highlighted components related to CT as well as components of problem based learning using competing narratives.⁵³ The program included a note-taking activity, mind map activity and decision-making activity, all of which provided guidance in making critical decisions regarding selected topics, such as protein and organic foods.⁵³

Topic Choice

The topics chosen for the modules were based on food system sustainability themes that included animal versus plant-based sources of protein as well as organic versus non-organic food.⁵³ These specific topics were chosen as they can be seen as authentic and relatable scenarios that college students are presented with every day when making decisions about their food choices.⁵³ Both of the issues can be argued from multiple perspectives, which is an important concept to consider when designing programs or instruments to measure changes in critical thinking.⁵³ Students are presented with opposing narratives that are complex and require evaluation skills beyond basic knowledge. The two topics increase in their difficulty to evaluate. The first topic of animal versus plant-based proteins can be seen as more straightforward, as the pros and cons for each side can be clearly determined.^{55,56} The second topic, on the other hand is not as straightforward. Organic versus non-organic foods involve more equivocal reasons for the pros and cons of each side, making it more difficult for the student to critically make a decision.^{57,58}

Students examined these conflicting arguments and developed their own solutions for solving open-ended problems by evaluating and analyzing evidence-based claims.⁵³ These abilities are encapsulated in the definition of critical decision making, where analyzing information, recognizing gaps in evidence and forming logical conclusions are three distinct constructs all essential for making critical decisions.⁴³ Although this problem-based learning program increased critical thinking decision making skills as well as critical thinking disposition (CTD), “an individual’s internal motivation to use critical thinking skills”,⁵⁹ a need exists to explore how other

forms of critical thinking appraisal, such as critical nutrition literacy, can be examined through this type of program.

V. Nutrition Literacy and Knowledge

The use of knowledge is often considered essential for change in attitudes and behaviors that lead to better health.^{60,61} However, the relationship between knowledge and behavior change is not always direct, positive, or linear.⁶¹ Oftentimes, there exists a gap between what professionals communicate to their clients and what their clients understand, which govern unhealthy behaviors.⁶² These unhealthy behaviors can lead to negative health outcomes, at both individual and community levels.^{7,10–13,62,63} Thus, it is important to explore how nutrition literacy may act as a mediator in the ability to understand and apply health information when needing to identify what is needed to achieve positive health outcomes.

Individuals with inadequate literacy tend to have difficulty with both written and oral forms of communication when in clinical settings.⁶⁴ Interventions related to health promotion should seek to directly address factors influencing diet related knowledge instead of solely focusing on disseminating information.⁶⁴ As a result, the availability of healthy foods coupled with dietary knowledge is likely to lead to an increased consumption of healthy foods.⁶⁴

Van der Heide et al⁶⁵ aimed to study whether health literacy is a pathway by which level of education affects health status. Health literacy was measured by the Health Activities and Literacy scale, using data from a sample of 5,136 adults.⁶⁵ Health literacy was found to partially mediate the association between low education and low self-report health status.⁶⁵ It can be concluded that improving health literacy

may be a useful strategy for reducing disparities in health related to education.⁶⁵ Thus, embedding literacy and health education instruction into education curricula may prove beneficial.⁶⁴

College health and nutrition courses are uniquely positioned to play a role in facilitating development of nutrition related behaviors among college students.⁶⁶ Previous research has recommended nutrition education interventions for first-year university students to increase knowledge and health behaviors.^{66,67} One recent study sought to determine the differences in pre and post food label and food choice scores among first-year college students at the beginning and end of the semester and how this may influence behavior.⁶⁶ There was a statistically significant difference with an increase in food label–reading behavior ($p < 0.01$) and food choice behavior ($p < 0.01$).⁶⁶ It was also determined through case analyses that 27% of students practiced food label reading more frequently in at least one category above at post assessment and 29% indicated choosing healthier food options more frequently.⁶⁶ Tallant⁶⁶ concluded that assisting students at the classroom level to improve food label–reading skills can build their self-efficacy in and knowledge about making healthy nutrition choices that can offset weight gain and adverse health effects in the future. Although this study proved a significant association, it failed to incorporate skills that go beyond food label reading. Thus, evaluation of increases in critical nutrition literacy scores after exposure to a nutrition intervention must be investigated. Is important to explore how critical nutrition literacy may play a role in how students use their knowledge when making appropriate nutrition decisions that can lead to positive health outcomes.

VI. Conclusion

Based on the literature reviewed above, findings indicate that several measures have been developed to assess the three levels of nutrition literacy.^{3,4,22,68} The two instruments developed to measure the functional level of nutrition literacy solely focus on numeracy and other basic literacy skills.^{22,69} When examining interactive nutrition literacy, the four instruments developed go beyond the basic, functional level of nutrition literacy by incorporating items that assess how information is applied to changing circumstances;^{31,68,70,71} however, they fail to assess higher level skills such as critically analyzing and applying information. When examining the highest level of nutrition literacy, CNL, two instruments have been developed.^{3,4} Although both instruments are internally consistent and reliable, they lack validation in terms of constructs and criteria.

This review shows that is important to examine CNL in respect to criteria, specifically diet quality. Utilizing instruments that involve functional and interactive levels of nutrition literacy have shown that a relationship between nutrition literacy and diet quality exists.^{70,72} However, to the writer's knowledge, there have been no studies that examine CNL in relation to diet.

When examining nutrition literacy, it is important to consider the use of critical thinking skills when making informed decisions about health. When exploring the relationship between health literacy and constructs such as critical thinking and critical decision making, an association exists.^{21,49} Currently, there has been no previous research focused on critical decision making in relation to nutrition literacy, specifically critical nutrition literacy and thus must be examined.

Finally, research exploring knowledge in relation to critical nutrition literacy is also lacking. One study has examined the use of functional nutrition literacy skills, specifically label reading abilities, and found a significant increase in these abilities.⁶⁶ Thus, it is apparent to go beyond these basic abilities and measure change in higher levels, such as CNL.

After a measure has demonstrated criteria for internal consistency and reliability, criterion-related and/or construct validity must be explored in specific populations, according to Redding et al.'s sequential measurement development process.⁷³ Thus, future research should follow this process in order to fully assess whether instruments to measure CNL have met validity criteria.

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B. CNL ITEMS BY FACTOR 1 AND FACTOR 2

Factor 1

I have confidence in the various diets that I read about in newspapers, magazines, etc.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I am confident that the media's presentation of new scientific findings concerning a healthy diet is correct.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I often refer to newspapers and magazines if I discuss diet with others.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I am influenced by the dietary advice that I read about in newspapers, magazines, etc.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

Factor 2

I am critical of the dietary information that I receive from various sources in society.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I am concerned that the dietary information that I read may not be based on science.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I base my diet on information that I get from scientifically recognized literature (for instance, the journals published by the American Medical Association and the Dietary Guidelines for Americans).

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

C. BEPS SURVEY ITEMS

There are resources on campus for a person who needs help managing stress.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I can not afford to eat healthy.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

It is easy to find healthy foods on campus.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

There are programs on campus that offer stress management.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I do not have enough time to pack healthy snacks for myself.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

The recreation center on campus is open when I want to workout.

- Strongly Disagree (1)

- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

It is easy to find fruits and vegetables on campus.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

My campus has a system of support for emotional or psychological problems.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I have access to food preparation equipment where I live.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

Friends motivate me to workout.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I can get an appointment with a mental health professional should or when I need it.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)

- Choose not to answer (6)

The people I eat with make it easy to choose healthy foods.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

There are sports (intramural or club) available to play on campus.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

There are a variety of healthy foods available on campus.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

There are plenty of opportunities on campus to be moderately or vigorously active.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

My class schedule makes it easy to eat healthy meals.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

There are resources on campus for a person who is in an abusive relationship.

- Strongly Disagree (1)
- Disagree (2)

- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

It is hard to eat healthy because of all the stress at school.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

Friends have a positive influence on my physical activity.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

My campus makes it easy to eat healthy.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I feel welcome to use the recreation center on campus.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

It is easy to live a healthy lifestyle while living on campus.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I see people being physically active on campus.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I can prepare meals where I live.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

What is your height?

Feet (4) _____

Inches (5) _____

Choose not to answer (6)

What is your weight (in pounds)?

Pounds (1) _____

Choose not to answer (2)

How would you describe your weight?

- Very under weight (1)
- Slightly under weight (2)
- About the right weight (3)
- Slightly over weight (4)
- Very over weight (5)

Which of the following are you trying to do about your weight?

- Lose weight (1)
- Gain weight (2)
- Stay the same weight (3)
- I am not trying to do anything about my weight (4)

How do you feel about your current weight?

- I am happy with my weight (1)
- I don't care about my current weight (2)
- I am upset about my current weight (3)
- Choose not to answer (4)

What is your desired weight (in pounds)?

Pounds (1) _____

Choose not to answer (2)

IPAQ

During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

- 0 days (1)
- 1 day (2)
- 2 days (3)
- 3 days (4)
- 4 days (5)
- 5 days (6)
- 6 days (7)
- 7 days (8)
- Choose not to answer (9)

How much time did you usually spend doing vigorous physical activities on one of those days?

- Did not do vigorous physical activities (1)
- 10 minutes (2)
- 20 minutes (3)
- 30 minutes (4)
- 40 minutes (5)
- 50 minutes (6)
- 60 minutes (7)
- 70 minutes (1 hr 10 min) (8)
- 80 minutes (1 hr 20 min) (9)
- 90 minutes (1 hr 30 min) (10)
- 100 minutes (1 hr 40 min) (11)
- 110 minutes (1 hr 50 min) (12)
- 120 minutes (2 hrs) (13)
- 130 minutes (2 hrs 10 min) (14)
- 140 minutes (2 hrs 20 min) (15)
- 150 minutes (2 hrs 30 min) (16)
- 160 minutes (2 hrs 40 min) (17)
- 170 minutes (2 hrs 50 min) (18)
- 180 + minutes (3 hrs or more) (19)
- Don't know/not sure (20)
- Choose not to answer (21)

During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

- 0 days (1)
- 1 day (2)
- 2 days (3)
- 3 days (4)
- 4 days (5)
- 5 days (6)
- 6 days (7)
- 7 days (8)
- Choose not to answer (9)

How much time did you usually spend doing moderate physical activities on one of those days?

- Did not do moderate physical activities (1)
- 10 minutes (2)
- 20 minutes (3)
- 30 minutes (4)
- 40 minutes (5)
- 50 minutes (6)
- 60 minutes (7)
- 70 minutes (1 hr 10 min) (8)
- 80 minutes (1 hr 20 min) (9)
- 90 minutes (1 hr 30 min) (10)
- 100 minutes (1 hr 40 min) (11)
- 110 minutes (1 hr 50 min) (12)
- 120 minutes (2 hrs) (13)
- 130 minutes (2 hrs 10 min) (14)
- 140 minutes (2 hrs 20 min) (15)
- 150 minutes (2 hrs 30 min) (16)
- 160 minutes (2 hrs 40 min) (17)
- 170 minutes (2 hrs 50 min) (18)
- 180 + minutes (3 hrs or more) (19)
- Don't know/not sure (20)
- Choose not to answer (21)

During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

- 0 days (1)
- 1 day (2)
- 2 days (3)
- 3 days (4)
- 4 days (5)

- 5 days (6)
- 6 days (7)
- 7 days (8)
- Choose not to answer (9)

How much time did you usually spend walking on one of those days?

- Did not walk (1)
- 10 minutes (2)
- 20 minutes (3)
- 30 minutes (4)
- 40 minutes (5)
- 50 minutes (6)
- 60 minutes (7)
- 70 minutes (1 hr 10 min) (8)
- 80 minutes (1 hr 20 min) (9)
- 90 minutes (1 hr 30 min) (10)
- 100 minutes (1 hr 40 min) (11)
- 110 minutes (1 hr 50 min) (12)
- 120 minutes (2 hrs) (13)
- 130 minutes (2 hrs 10 min) (14)
- 140 minutes (2 hrs 20 min) (15)
- 150 minutes (2 hrs 30 min) (16)
- 160 minutes (2 hrs 40 min) (17)
- 170 minutes (2 hrs 50 min) (18)
- 180 + minutes (3 hrs or more) (19)
- Don't know/not sure (20)
- Choose not to answer (21)

During the last 7 days, how much time did you spend sitting on a week day?

- 10 minutes (1)
- 20 minutes (2)
- 30 minutes (3)
- 40 minutes (4)
- 50 minutes (5)
- 60 minutes (6)
- 70 minutes (1 hr 10 min) (7)
- 80 minutes (1 hr 20 min) (8)
- 90 minutes (1 hr 30 min) (9)
- 100 minutes (1 hr 40 min) (10)
- 110 minutes (1 hr 50 min) (11)
- 120 minutes (2 hrs) (12)
- 130 minutes (2 hrs 10 min) (13)
- 140 minutes (2 hrs 20 min) (14)
- 150 minutes (2 hrs 30 min) (15)

- 160 minutes (2 hrs 40 min) (16)
- 170 minutes (2 hrs 50 min) (17)
- 180 + minutes (3 hrs or more) (18)
- Don't know/not sure (19)
- Choose not to answer (20)

DSQ

During the past month, how often did you eat hot or cold cereals? Mark one.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, what kind of cereal did you usually eat. (Search types of cereal by clicking on the box and typing the first letter of the cereal).

Was there another cereal you usually ate? Please specify. (Search types of cereal by clicking on the box and typing the first letter of the cereal). (To select more than one type of cereal, hold down the "control" button while choosing each answer).

During the past month, how often did you have any milk (either to drink or on cereal)? Include regular milks, chocolate or other flavored milks, lactose-free milk, buttermilk. Please do not include soy milk or small amounts of milk in coffee or tea. Mark one.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2-3 times per day (9)
- 4-5 times per day (10)
- 6 or more times per day (11)

Skip To: If During the past month, how often did you have any milk (either to drink or on cereal)?

During the past month, what kind of milk did you usually drink? Mark one.

- Whole or regular milk (1)
 - 2% fat or reduced-fat milk (2)
 - 1%, 1/2%, or low-fat milk (3)
 - Fat-free, skim, or nonfat milk (4)
 - Soy milk (5)
 - Other kind of milk (please specify) (6)
-

During the past month, how often did you drink regular soda or pop that contains sugar? Do not include diet soda. Mark one.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2-3 times per day (9)
- 4-5 times per day (10)
- 6 or more times per day (11)

During the past month, how often did you drink 100% pure fruit juices such as orange, mango, apple, grape and pineapple juices? Do not include fruit-flavored drinks with added sugar or fruit juice you made at home and added sugar to. Mark one.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2-3 times per day (9)
- 4-5 times per day (10)
- 6 or more times per day (11)

During the past month, how often did you drink coffee or tea that had sugar or honey added to it? Include coffee and tea you sweetened yourself and presweetened tea and coffee drinks such as Arizona Iced Tea and Frappuccino. Do not include artificially sweetened coffee or diet tea.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2-3 times per day (9)
- 4-5 times per day (10)
- 6 or more times per day (11)

During the past month, how often did you drink sweetened fruit drinks, sports or energy drinks, such as Kool-Aid, lemonade, Hi-C, cranberry drink, Gatorade, Red Bull or Vitamin

Water? Include fruit juices you made at home and added sugar to. Do not include diet drinks or artificially sweetened drinks.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2-3 times per day (9)
- 4-5 times per day (10)
- 6 or more times per day (11)

During the past month, how often did you eat fruit? Include fresh, frozen or canned fruit. Do not include juices.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat a green leafy or lettuce salad, with or without other vegetables?

- Never (1)

- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat any kind of fried potatoes, including french fries, home fries, or hash brown potatoes?

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat other kind of potatoes, such as baked, broiled, mashed potatoes, sweet potatoes, or potato salad?

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat refried beans, baked beans, beans in soup, pork and beans, or any other type of cooked dried beans? Do not include green beans.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat brown rice or other cooked whole grains, such as bulgur, cracked wheat, or millet? Do not include white rice.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, not including what you just told me about (green salads, potatoes, cooked dried beans), how often did you eat other vegetables?

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you have Mexican-type salsa made with tomato?

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat pizza? Include frozen pizza, fast food pizza, and homemade pizza.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)

- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you have tomato sauces such as with spaghetti or noodles or mixed into foods such as lasagna? Do not include tomato sauce on pizza.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat any kind of cheese? Include cheese as a snack, cheese on burgers, sandwiches, and cheese in foods such as lasagna, quesadillas, or casseroles. Do not include cheese on pizza.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat red meat, such as beef, pork, ham, or sausage? Do not include chicken, turkey or seafood. Include red meat you had in sandwiches,

lasagna, stew, and other mixtures. Red meats may also include veal, lamb, and any lunch meats made with these meats.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat any processed meat, such as bacon, lunch meats, or hot dogs? Include processed meats you had in sandwiches, soups, pizza, casseroles, and other mixtures. Processed meats are those preserved by smoking, curing, or salting, or by the addition of preservatives. Examples are: ham, bacon, pastrami, salami, sausages, bratwursts, frankfurters, hot dogs, and spam.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat whole grain bread including toast, rolls and in sandwiches? Whole grain breads include whole wheat, rye, oatmeal and pumpernickel. Do not include white bread.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat chocolate or any other types of candy? Do not include sugar-free candy.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat doughnuts, sweet rolls, Danish, muffins, pan dulce, or pop-tarts? Do not include sugar-free items.

- Never (1)

- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat cookies, cake, pie or brownies?

Do not include sugar-free kinds.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat ice cream or other frozen desserts?

Do not include sugar-free kinds.

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

During the past month, how often did you eat popcorn?

- Never (1)
- 1 time last month (2)
- 2-3 times last month (3)
- 1 time per week (4)
- 2 times per week (5)
- 3-4 times per week (6)
- 5-6 times per week (7)
- 1 time per day (8)
- 2 or more times per day (9)

Would you say that in general your health is

- Excellent (1)
- Very good (2)
- Good (6)
- Fair (7)
- Poor (8)
- Don't know/not sure (3)
- Choose not to answer (4)

Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?

- Number of days (1) _____
- None (2)
- Don't know/not sure (3)
- Choose not to answer (4)

Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?

- Number of days (1) _____
- None (2)
- Don't know/not sure (3)
- Choose not to answer (4)

During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?

- Number of days (1) _____
- None (2)
- Don't know/not sure (3)
- Choose not to answer (4)

During the past 30 days, for about how many days did PAIN keep you from doing your usual activities, such as self-care, work, or recreation?

- Number of days (1) _____
- None (2)
- Don't know/not sure (3)
- Choose not to answer (4)

During the past 30 days, for about how many days have you felt SAD, BLUE, or DEPRESSED?

- Number of days (1) _____
- None (2)

- Don't know/not sure (3)
- Choose not to answer (4)

During the past 30 days, for about how many days have you felt WORRIED, TENSE, or ANXIOUS?

- Number of days (1)

- None (2)
- Don't know/not sure (3)
- Choose not to answer (4)

During the past 30 days, for about how many days have you felt you did NOT get ENOUGH REST or SLEEP?

- Number of days (1)

- None (2)
- Don't know/not sure (3)
- Choose not to answer (4)

During the past 30 days, for about how many days have you felt VERY HEALTHY AND FULL OF ENERGY?

- Number of days (1)

- None (2)
- Don't know/not sure (3)
- Choose not to answer (4)

How often do you prepare meals at home?

- Never/NA (1)
- 1-3 times/month (2)
- 1-4 times/week (3)
- 5 times/week or more (4)

How often do you cook meals from scratch or fresh ingredients?

- Never/NA (1)
- 1-3 times/month (2)
- 1-4 times/week (3)
- 5 times/week or more (4)

I have confidence in the various diets that I read about in newspapers, magazines, etc.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)

- Strongly agree (5)
- Choose not to answer (6)

I am critical of the dietary information that I receive from various sources in society.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am concerned that the dietary information that I read may not be based on science.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I believe my body tells me what it needs in terms of nutrients, regardless of researchers' opinions about this.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am confident that the media's presentation of new scientific findings concerning a healthy diet is correct.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am familiar with the criteria for scientifically based content in health claims.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I often refer to newspapers and magazines if I discuss diet with others.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am influenced by the dietary advice that I read about in newspapers, magazines, etc.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am confident that some of the methods within alternative medicine (such as health foods) provide me with credible dietary advice.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I find it hard to distinguish scientific nutritional information from non-scientific nutritional information.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I base my diet on information that I get from scientifically recognized literature (for instance, the journals published by the American Medical Association and the Dietary Guidelines for Americans).

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

How old are you?

- Less than 18 (1)
- 18 (2)
- 19 (3)
- 20 (4)
- 21 (5)
- 22 (6)
- 23 (7)
- 24 (8)
- More than 24 years old (9)
- Choose not to answer (10)

What is your ethnicity?

- White (1)
- Hispanic or Latino (2)
- Black or African American (3)
- Native American or American Indian (4)
- Asian/Pacific Islander (5)
- Other (6)
- Choose not to answer (7)

Do you live on campus or off campus?

- On campus (1)
- Off campus (2)
- Choose not to answer (3)

What is your gender identity?

- Male (1)
- Female (2)
- Choose not to answer (3)

Which university do you attend?

- University of Rhode Island (1)
- South Dakota State University (2)
- Rutgers University (3)
- West Virginia University (4)
- University of Tennessee (5)
- University of New Hampshire (6)
- University of Florida (7)
- University of Maine (8)

How many minutes did it take you to complete this survey?

- 1 min. or less (1)

- 2-5 min (2)
- 6-10 min. (3)
- 11-15 min. (4)
- 16-20 min. (5)
- 21-25 min. (6)
- 26-30 min. (7)
- 31-35 min. (8)
- More than 35 min. (9)
- Choose not to answer (10)

How many times have you taken this survey before?

- Never (1)
- 1 time (2)
- 2 times (3)
- 3 times (4)
- 4 times (5)
- 5 times (6)
- More than 5 times (7)
- Choose not to answer (8)

What class are you taking this for?

- Larson 210 (1)
- Larson 8am (2)
- Melanson 9am (3)
- Melanson 10 (4)
- Nelson 7pm (5)

Please enter student ID:

D. CRITICAL THINKING PRE-INSTRUMENT

How old are you?

What gender do you identify with?

- Male (0)
- Female (1)
- Choose not to answer (2)

What is your race/ethnicity?

- White (1)
- Hispanic or Latino (2)
- Black or African American (3)
- Native American or American Indian (4)
- Asian/Pacific Islander (5)
- Other (6)
- Choose not to answer (7)

What is your major? (Drop down list)

What class was this offered in for extra credit? (Drop down list)

Do you live on campus or off campus?

- On campus (1)
- Off campus (2)
- Choose not to answer (3)

The most recent time you looked for information about health or nutrition topics, where did you go first? Please choose one response:

- Books (1)
- Family (2)
- Internet (3)
- Newspapers (4)
- Brochures, pamphlets, etc. (5)
- Doctor or health care provider (6)
- Telephone information number (7)
- Friend/co-worker (8)
- Library (9)
- Magazines (10)
- Choose not to answer (11)

I have confidence in the various diets that I read about in newspapers, magazines, etc.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)

- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am critical of the dietary information that I receive from various sources in society.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am concerned that the dietary information that I read may not be based on science.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I believe my body tells me what it needs in terms of nutrients, regardless of researchers' opinions about this.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am confident that the media's presentation of new scientific findings concerning a healthy diet is correct.

- Strongly disagree (3)
- Somewhat disagree (2)
- Neither agree nor disagree (1)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am familiar with the criteria for scientifically based content in health claims.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)

- Choose not to answer (6)

I often refer to newspapers and magazines if I discuss diet with others.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am influenced by the dietary advice that I read about in newspapers, magazines, etc.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am confident that some of the methods within alternative medicine (such as health foods) provide me with credible dietary advice.

- Strongly disagree (1)
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- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
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I find it hard to distinguish scientific nutritional information from non-scientific nutritional information.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I base my diet on information that I get from scientifically recognized literature (for instance, the journals published by the American Medical Association and the Dietary Guidelines for Americans).

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I often find myself questioning things I hear or read in my courses to decide if I find them convincing.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

When a theory, interpretation, or conclusion is presented in class or in a reading, I try to decide if there is good supporting evidence.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I treat course material as a starting point and try to develop my own ideas about it.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I try to play around with ideas of my own related to what I'm learning in my courses.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

Whenever I read or hear an assertion or conclusion in a class, I think about possible alternatives.

- Strongly Disagree (1)
- Disagree (2)
- Neutral (3)
- Agree (4)
- Strongly Agree (5)
- Choose not to answer (6)

I tend to make decisions based on my personal opinion rather than facts.

- 0 (Strongly Disagree) to 10 (Strongly Agree)

"Green Eating is: Eating locally grown foods, limited amounts of processed/ fast foods, eating meatless meals at least one day per week, choosing organic foods as much as possible, and only taking what you plan on eating." Are you a Green Eater?

- No, and I do not intend to start within the next 6 months
- No, but I am thinking about becoming a green eater within the next 6 months
- No, but I am planning on becoming a green eater within the next 30 days
- Yes, I am a green eater and have been for less than 6 months
- Yes, I am a green eater and have been doing so for 6 months or more
- Choose not to answer

Locally grown foods are grown within 100 miles of your location. Based on this, how often do you eat locally grown foods?

- Barely ever to never (1)
- Rarely (25%) (2)
- Sometimes (50%) (3)
- Often (75%) (4)
- Almost always (5)
- Choose not to answer (6)

When in season, how often do you shop at farmer's markets?

- Barely ever to never (1)
- Rarely (25%) (2)
- Sometimes (50%) (3)
- Often (75%) (4)
- Almost always (5)
- Choose not to answer (6)

How often do you choose foods that are labeled as certified organic?

- Barely ever to never (1)
- Rarely (25%) (2)
- Sometimes (50%) (3)
- Often (75%) (4)
- Almost always (5)
- Choose not to answer (6)

How often do you select meats, poultry, and dairy products that are raised without antibiotics or hormones?

- Barely ever to never (1)
- Rarely (25%) (2)
- Sometimes (50%) (3)
- Often (75%) (4)
- Almost always (5)
- Choose not to answer (6)

How often do you select food or beverages that are labeled as fair trade certified?

- Barely ever to never (1)
- Rarely (25%) (2)
- Sometimes (50%) (3)
- Often (75%) (4)
- Almost always (5)
- Choose not to answer (6)

How often do you buy meat or poultry products labeled "free range" or "cage free"?

- Barely ever to never (1)
- Rarely (25%) (2)
- Sometimes (50%) (3)
- Often (75%) (4)
- Almost always (5)
- Choose not to answer (6)

How often do you try not to waste food?

- Barely ever to never (1)
- Rarely (25%) (2)
- Sometimes (50%) (3)
- Often (75%) (4)
- Almost always (5)
- Choose not to answer (6)

E. GUIDED SCORING SYSTEM FOR CRITICAL DECISION-MAKING

SCORE

Q1 Student ID:

Q2 Did the student make a decision?

No (0)

Yes (10)

Q3 Did the student refer to a health value?

No (0)

Yes, 1 time (5)

Yes, 2 times (10)

Yes, 3 or more times (15)

Q4 Did the student refer to animal care?

No (0)

Yes, 1 time (5)

Yes, 2 times (10)

Yes, 3 or more times (15)

Q5 Did the student refer to cost?

No (0)

Yes, 1 time (5)

Yes, 2 times (10)

Yes, 3 or more times (15)

Q6 Did the student refer to the environment?

No (0)

Yes, 1 time (5)

Yes, 2 times (10)

Yes, 3 or more times (15)

Q7 Did the student refer to a different evidence-based reason?

No (0)

Yes, 1 time. It was: (5) _____

Yes, 2 times. It was: (10) _____

Yes, 3 times. It was: (15) _____

Q8 Did the student discuss alternative points of view on the topic?

No (0)

Yes (5)

Q9 If alternative point of view provided, what was the reasoning?

F. CRITICAL DECISION-MAKING RUBRIC

Point Value	Description
30	Student provides a recommendation and explains the decision, using supporting evidence. The recommendation refers to at least three points from the following dimensions: health value, animal care, cost, environmental impacts. The student discusses alternative points of view on the topic.
20	Student provides a recommendation and explains the decision but may use limited supporting evidence. The recommendation refers to at least three of the following dimensions of the topic: health value, animal care, cost, environmental impacts, but doesn't discuss alternative points of view on the topic. OR the student discusses alternative points of view but refers to less than three of the dimensions.
10	Student provides a recommendation but does not explain the decision, OR student explains solution but does not provide a recommendation. The recommendation refers to one of the following dimensions of the topic: health value, animal cost, environmental impacts.
0	Student does not respond or fails to address the task.

G. NUTRITION INTERVENTION SURVEY ITEMS

How old are you?

What gender do you identify with?

- Male (0)
- Female (1)
- Choose not to answer (2)

What is your race/ethnicity?

- White (1)
- Hispanic or Latino (2)
- Black or African American (3)
- Native American or American Indian (4)
- Asian/Pacific Islander (5)
- Other (6)
- Choose not to answer (7)

What is your major? (Drop down list)

Do you live on campus or off campus?

- On campus (1)
- Off campus (2)
- Choose not to answer (3)

I have confidence in the various diets that I read about in newspapers, magazines, etc.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am confident that the media's presentation of new scientific findings concerning a healthy diet is correct.

- Strongly disagree (3)
- Somewhat disagree (2)
- Neither agree nor disagree (1)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I often refer to newspapers and magazines if I discuss diet with others.

- Strongly disagree (1)
- Somewhat disagree (2)

- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I am influenced by the dietary advice that I read about in newspapers, magazines, etc.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)

I find it hard to distinguish scientific nutritional information from non-scientific nutritional information.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neither agree nor disagree (3)
- Somewhat agree (4)
- Strongly agree (5)
- Choose not to answer (6)