Factors predicting perceptions of meat and dairy foods among college students at a land-grant institution: an observational, analytical study

by

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B.S., Kansas State University, 2020

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Food, Nutrition, Dietetics and Health
College of Health and Human Sciences

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2021

Approved by:

Major Professor
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Abstract

Meat and dairy consumption are staples of the typical American diet, yet interest in plant-based dietary patterns has been increasing in recent years. Perceptions of red meat, dairy products, and their plant-based alternatives are relatively unknown in college-aged students, who are unique in the sense that many are likely making their own food intake decisions for the first time. The purpose of this observational, analytical study was to determine the predictive value of student characteristics for attitudes regarding red meat and dairy consumption as well as plant-based alternatives to these types of foods. A modified version of a previously validated 25-item survey that included 12 items related to perceptions of red meat consumption, 11 items related to perceptions of dairy consumption, and two items related to perceptions of plant-based alternatives to red meat and dairy consumption was distributed to students attending Kansas State University. A stratified random sample was determined, resulting in 5,300 surveys being distributed and 528 being fully completed, for a 10% completion rate overall. Demographic information, including age, gender, race/ethnicity, college affiliation, reported dietary pattern, educational attainment, self-reported level of agricultural knowledge and the size of the population in which the students were primarily raised was also collected. Preliminary data analyses indicated that a majority of survey participants were female (67.2%), ages 18–25 (89%), white (86.8%), fell into the late undergraduate academic level (juniors and seniors, 53.2%), and consumed an omnivorous dietary pattern (91.7%), with a somewhat even distribution of participants falling into each population size and self-reported level of agricultural knowledge category. Survey respondents were representative of the larger university population as well as all individual colleges (excluding the College of Veterinary Medicine which was not represented). Data dimensionality reduction procedures included a principal component analysis

that revealed five unique factors and included a subsequent factor analysis that confirmed the five factors. A series of linear regressions was then performed to determine the predictor variables that explained the variability in perceptions of red meat and dairy intake, as well as plant-based alternatives. The five factors revealed through the principal component analysis were positive perceptions of red meat (factor 1), negative perceptions of red meat (factor 2), negative perceptions of toxins, hormones, and antibiotics in red meat (factor 3), negative perceptions of dairy products (factor 4), and positive perceptions of dairy products (factor 5). The consistent significant predictors of agreement with attitudes toward red meat and dairy consumption across all five factors were college affiliation and dietary pattern. Participants identifying as students in the College of Agriculture and participants consuming an omnivorous diet indicated significantly stronger agreement with more positive perceptions of red meat and dairy across all five factors compared to all other college affiliations and reported dietary patterns, respectively. Additionally, race/ethnicity was a significant predictor for factors 1 and 2, self-reported level of agricultural knowledge was a significant predictor for factors 1 and 3, and the size of the population in which the students were primarily raised was a significant predictor in the model for factors 2, 3, and 4. Kansas State University is a land grant, agriculturally oriented university with a relatively homogenous student population, and high levels of participation in diets that include animal products. Therefore, despite recent trends of increasing interest in and consumption of plant-based dietary patterns, students at Kansas State University tend to maintain positive perceptions of red meat and dairy. In the future, the results of this study can be used to tailor education regarding red meat, dairy, and plant-based alternatives to students with differing educational backgrounds and dietary patterns, develop a more thorough measurement of perceptions of plant-based dietary patterns, and inform research that determines additional

predictors that may be associated with college-aged students' perceptions of red meat, dairy, and plant-based alternatives.

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Acknowledgements

I would first like to thank my major Professor, Dr. Sara Rosenkranz. You have been not only a patient teacher and reliable mentor but also a trusted confidant throughout this process. I could not have completed this work without your steadfast support and encouragement.

Secondly, thank you to the members of my committee, Dr. Richard Rosenkranz and Dr. Kevin Sauer. Your expertise and feedback and have been invaluable to me.

Finally, I would like to thank both Dr. Linda Yarrow and Mrs. Brittany Dennis, whose research served as the catalyst for this thesis. It has been a privilege to continue your work.

Chapter 1 - Introduction

Meat and dairy consumption underpin the usual "Western" diet, with most Americans including these foods in their diet in order to meet the guidelines for consumption of protein (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). A typical Western diet is comprised of large portions of calorically dense and nutrient-poor foods including processed meat, refined grains, and pre-packaged foods (Cordain et al., 2005). However, meat and dairy consumption can be a part of a healthy diet, as they both provide not only good sources of protein, but also a variety of micronutrients (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020).

Despite their nutrient-related benefits, there is a substantial body of research that consistently suggests that dietary patterns that include excessive amounts of animal products are associated with an increased risk of some of the most common non-communicable chronic diseases. For example, a large-scale randomized controlled trial and a literature review of vegetarian diets indicated that there is evidence linking red meat consumption (particularly processed meat) to an increased risk of coronary heart disease, colorectal cancer, and type two diabetes mellitus (T2DM) (Martínez-González et al., 2014; McEvoy et al., 2012). The Dietary Guidelines for Americans also indicate that there is strong evidence of a reduction in CVD risk and moderate evidence of a reduction in obesity, T2DM, and some cancer risk associated with eating patterns that incorporate lower intakes of red meat and processed meats (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). Independent of health-related concerns regarding consumption of excessive amounts of animal products, there are

important environmental consequences for the global population, including methane production from the meat industry (Godfray et al., 2018). Some other concerns include the emissions created by meat production, biodiversity loss, and high freshwater demand associated with red meat production (Aiking, 2014; Sabaté & Soret, 2014). Regarding dairy products, high levels of water usage and greenhouse gas emissions associated with dairy production and processing are important environmental issues (Milani et al., 2011). In addition to the aforementioned mainstream concerns, other concerns related to animal product consumption are less well studied, and more ambiguous issues. A meta-analysis of population-based cohort studies indicated that increased whole milk intake was significantly associated with an increase in prostate cancer mortality risk in men (Lu et al., 2016). There is also some limited evidence from prospective cohort studies that the risk of ovarian cancer is increased with high intakes of lactose and dairy foods (Larsson et al., 2006). Additionally, intake of high-fat dairy has been associated with higher risk of mortality following breast cancer diagnosis (Kroenke et al., 2013). Some other equivocal concerns are related to whether humans are "meant" to consume dairy given that there is a high prevalence of lactose intolerance in the American population (Storhaug et al., 2017). Some believe that consumption of dairy products leads to the overproduction of mucus and may promote allergy like symptoms and inflammation, although evidence from a systematic review of randomized controlled trials found that this is only the case if a milk allergy is present (Bordoni et al., 2017; Ulven et al., 2019).

Due, in part, to evidence indicating negative health and environmental impacts from excessive animal product consumption, interest and participation in plant-based dietary patterns in North America has increased (Medawar et al., 2019). Plant based dietary patterns include higher intakes of fruits, vegetables, whole grains, legumes, fish, and poultry than the typical

western diet, and do not require the exclusion of meat or dairy products completely (Wong, 2014). A recently published narrative review indicated that in the United States, eating a plant-based diet, achieved by replacing red and processed meats with other sources of protein, was associated with a lower risk of mortality, T2DM, stroke, and CHD (Godfray et al., 2018). Additionally, as shown in a prospective cohort study, consuming plant protein in replacement of animal protein was associated with lower mortality (Song et al., 2016).

College-aged students are of particular interest when it comes to making changes to dietary patterns because this population is in a critical time period of making independent choices about their dietary intake (Sogari et al., 2018). Evidence suggests that college-aged students may not prioritize the formation of healthy eating patterns and tend to overlook the importance of this time-period and stage as an opportunity for change (Brennan et al., 2020). Therefore, a better understanding of college students' perceptions about animal product consumption (meat and dairy) may provide important insights regarding the variables that predict whether students might purchase and consume animal products, as well as plant-based alternatives to these types of foods.

Given that the college-aged population is poorly studied with regard to these dietary intake issues, we sought to examine important student characteristics that elucidate the heterogeneity in perceptions of red meat and dairy intake among a college-student population at a land-grant university to determine how these predictors impact perceptions of red meat, dairy, and their plant-based alternatives. These characteristics included age, gender, race/ethnicity, college affiliation, reported dietary pattern, educational attainment, self-reported level of agricultural knowledge and the size of the population in which the students were primarily raised. The purpose of this observational, analytical study was to determine the predictive value

of student characteristics for attitudes regarding red meat and dairy consumption as well as plant-based alternatives to these types of foods.

Chapter 2 - Methods

A 25-item survey was developed by modifying a previously validated instrument for a study that sought to assess the perceptions of meat and dairy products among current and former non-vegetarian women (Barr & Chapman, 2002). The modified survey included 12 items related to meat consumption, and one item related to plant-based alternatives to meat consumption. The survey also included 11 items about perceptions of dairy consumption and one item related to plant-based alternatives to dairy consumption. The two plant-based alternative items were developed with the assistance of Dr. Susan Barr, an author of the aforementioned study, to address perceptions of plant-based meat and dairy alternatives. The full survey can be seen in Appendix A (Dennis, 2018). All survey items were scored from 1 to 5, with 1 indicating strongly disagree and 5 indicating strongly agree. Furthermore, additional questions were included in the survey to determine student demographic and background information: student age, gender, ethnicity/race, educational attainment, area of study (i.e., college, department and major), current dietary pattern (i.e., omnivorous, vegetarian, plant-based, vegan, lacto-vegetarian, ovo-vegetarian or pescatarian, with definitions of each dietary eating pattern provided), educational attainment (i.e., freshman, sophomore, junior, senior, masters level, or PhD level), self-reported high level of agricultural knowledge (i.e. strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree) and the size of the population in which the students were primarily raised (i.e. city/town with less than 10,000 people, city/town with 10,000–99,000 people, city/town with 100,000–999,000 people, city/town with 1,000,000 or more people, or unknown). Ethics approval for disseminating the survey at Kansas State University was obtained, and students completed an informed consent via Qualtrics indicating that they understood that

their data would be used for a research study. The survey was made available electronically through Qualtrics and was subsequently distributed to a stratified random sample of Kansas State University students across all colleges throughout the university to complete within ten days. The data for this paper were generated using Qualtrics software, Version April 2017 of Qualtrics. Copyright © 2021 Qualtrics.

The survey sample population of 5,300 students was determined via a stratified random sample based on criteria such as age, gender, race/ethnicity, and college within the university, and is representative of the total Kansas State University population. Out of the 5,300 surveys distributed, 564 surveys were opened but not submitted, with 556 partially completed and 528 fully completed, for a 10% completion rate. There were some dropouts at various points of survey completion, as denoted in the tables, with a minimum of 528 respondents remaining for any of the individual survey items.

Statistical Analyses

Once the survey closed, the data were exported to an excel file, checked, and cleaned, and then analyzed using IBM SPSS Statistics for Windows (Version 25.0 Armonk, NY: IBM Corp). A salutogenic scoring system was used, such that all questions with a negative implication toward red meat or dairy products were reverse scored. Reverse coding indicated that strongly agree was represented by a 1, and strongly disagree was represented by a 5. Following reverse scoring procedures, for all items, higher scores indicated more positive perceptions of red meat, dairy products, and their plant-based alternatives, while lower scores indicated more negative perceptions. In total, seven items retained the original scoring structure, while the remaining 18 questions were reverse scored. Means and standard deviations for all demographic variables were determined using descriptive analyses. Principal component analysis were conducted with

standardized survey items to reduce the dimensions of the survey to a usable form for further analyses. Eigenvalues of ≥ 1.0—indicating the factor explained a considerable amount of variance—were used to determine the number of factors present within the survey. Based on an assumption of limited inter-factor correlation, Varimax rotation with Kaiser Normalization was used to adjust factor loading of survey items. An item-to-factor loading ≥ 0.40 with no cross-loadings indicated a salient or meaningful relationship to each identified factor (Gorsuch, 1983). Cronbach's alpha coefficients were used to determine internal consistency reliability, with a coefficient ≥ 0.70 indicating adequate internal consistency of the corresponding factor (Gorsuch, 1983). There were no items eliminated, as there were no improvements to the alpha values with removal of any of the factor items.

Finally, linear regressions were performed for each of the five factors to determine the predictive value of student characteristics for attitudes regarding red meat and dairy consumption as well as plant-based alternatives to these types of foods. The predictor variables included gender (female=1, male=2); race/ethnicity (white=1, non-white=2); college affiliation (College of Agriculture=1, all other colleges=2); dietary pattern (omnivorous diet=1, all other dietary patterns that did not include meat=2); student level in college (early undergraduate (freshman/sophomore)=1, late undergraduate (junior/senior)=2, graduate student=3); population size estimate for the area they were primarily raised (0=unknown, 1=<10,000, 2=10,000–99,000, 3=100,000–999,000, 4=1,000,000 or more); and self-reported high level of agricultural knowledge (1=strongly disagree, 2=somewhat disagree, 3=neither agree nor disagree, 4=somewhat agree, 5=strongly agree). Statistical significance was set as $p<0.05$, with Bonferroni corrections for multiple tests within each regression model to minimize type 1 error.

Chapter 3 - Results

Participant Sample

The sample obtained was representative of the overall Kansas State University student population at the time of survey completion. Table 3.1 describes the survey sample population and completion rate. A comparison between the students who completed the survey, and the overall student population at Kansas State University is displayed in table 3.2. Notably, the sample was also representative of the population of most individual colleges. The College of Veterinary Medicine was the lone exception, as they were not represented in the sample population (0%) but make up 2.4% of the university population. Preliminary data analyses indicated that a majority of survey participants were female (67.2%), ages 18–25y (89%), white (86.8%), fell into the late undergraduate academic level (juniors and seniors, 53.2%), and consumed an omnivorous dietary pattern (91.7%), with a somewhat even distribution of participants falling into each population size and self-reported level of agricultural knowledge category. Full study sample demographics are displayed in table 3.3.

Table 3.1 – *University Population vs. Survey Sample Population Flowchart*

Total University Population
19,081
▼
Initial Outreach
5,300
▼

Survey Opened but Not Submitted

564

▼

Surveys Partially Completed

556

▼

Surveys Fully Completed

528

▼

Completion Rate

10%

Table 3.2 – ***Representation of University Population vs. Survey Sample Population***

	University Population (*n*)	**University Population (%)**	**Survey Sample Population (*n*)**	**Sample Population (%)**
Total Population	19,081		528	
Gender				
Male	9,774	51.2	173	32.6
Female	9,307	48.8	355	67.0

College				
College of Human Ecology	2,221	11.6	101	19.1
College of Agriculture	2,597	13.6	78	14.7
College of Architecture, Planning and Design	626	3.3	9	1.7
College of Arts and Sciences	5,438	28.5	122	23.0
College of Business Administration	2,448	12.8	86	16.2
College of Education	1,386	7.3	47	8.9
College of Engineering	3,756	19.7	85	16.0
College of Veterinary Medicine	450	2.4	0	0

Table 3.3 – *Demographics of Study Sample*

	n	**% of total**
Age		
18–25y	470	89.0
26–30y	35	6.6
31–35y	11	2.1
36–40y	9	1.7
>40y	3	0.6
Total	528	100

Gender		
Male	173	32.8
Female	355	67.2
Total	528	100
Ethnicity/Race		
Asian	17	3.2
Black or African American	15	2.8
White	460	86.8
Hispanic	25	4.7
Missing/Unknown	11	2.5
Total	528	100
College		
College of Human Ecology	101	19.1
College of Agriculture	78	14.8
College of Architecture, Planning and Design	9	1.7
College of Arts and Sciences	122	23.1
College of Business Administration	86	16.3
College of Education	47	8.9
College of Engineering	85	16.1
Total	528	100

Academic Level		
Early Undergraduate (Freshman/Sophomore)	178	33.7
Late Undergraduate (Junior/Senior)	281	53.2
Graduate Student	69	13.1
Total	528	100
Dietary Eating Pattern		
Omnivorous	486	91.7
Vegetarian	8	1.5
Plant-Based	26	4.9
Vegan	1	0.2
Lacto-Vegetarian	1	0.2
Pescatarian	3	0.6
Other	3	0.6
Total	528	100
Population Size		
Unknown	8	1.5
<10,000 people	190	36.0
10,000–99,000 people	145	27.5
100,000–999,000 people	147	27.8

>1,000,000	38	7.2
Total	528	100
High Agricultural Knowledge		
Strongly Disagree	58	11.0
Somewhat Disagree	139	26.4
Neither Agree Nor Disagree	128	24.3
Somewhat Agree	144	27.3
Strongly Agree	58	11.0
Total	527[a]	100

[a]Missing item for one survey respondent

Principal Component Analysis

Five factors emerged following principal component analysis. Full details of the principal component analysis are shown in table 3.4. The first factor (positive perceptions of red meat) included five survey items (Q5, Q7, Q8, Q10, and Q11) and represented items related to positive perceptions of flavor and healthfulness of red meat. The second factor (negative perceptions of red meat) included 5 survey items (RQ6, RQ16, RQ9, RQ15, and RQ17) and included items related to negative perceptions of digestibility, fat content, and sluggishness due to red meat. The third factor (negative perceptions of toxins, hormones, and antibiotics in red meat) included three survey items (RQ12, RQ13, and RQ14) and represented the construct of negative perceptions of red meat due to concerns regarding toxins, antibiotics, and hormones. The fourth factor (negative perceptions of dairy products) included seven survey items (RQ18, RQ21, RQ22, RQ26, RQ27,

RQ28, and RQ29) with items related to mucous, hormones, antibiotics, bloating, and gas. The fifth factor (positive perceptions of dairy products) included five items (RQ20, RQ24, Q19, Q23, and Q25) representing taste, protein and nutrients, and the ability to easily obtain calcium through dairy products. Details for the factor loadings can be seen in table 3.4.

Table 3.4 – ***Factors Determined via Principal Component Analysis***

	Mean	**Standard Deviation**	**Factor Loading**	**Alpha**
Factor 1: Positive perceptions of red meat.	3.7	0.68		0.762
Q5 Flavor			0.778	
Q7 Part of a healthy diet			0.752	
Q8 Healthier than			0.688	
Q10 Important nutrients			0.651	
Q11 Healthy as fish and poultry			0.526	
Factor 2: Negative perceptions of red meat.	3.0	0.84		0.749
RQ6 Fish and poultry are best			0.743	
RQ16 Fat			0.662	
RQ9 Heavy and sluggish			0.639	
RQ15 Difficult digestion			0.613	
RQ17 Meat alternatives are healthier			0.478	

Factor 3: Negative perceptions of toxins, hormones, and antibiotics in red meat.	3.1	0.85		0.729
RQ14 Antibiotics			0.822	
RQ13 Hormones			0.779	
RQ12 Toxins			0.714	
Factor 4: Negative perceptions of dairy products.	3.2	0.76		0.805
RQ26 Hormones			0.781	
RQ27 Antibiotics			0.779	
RQ18 Gas and bloating			0.654	
RQ22 Saturated fat and cholesterol			0.623	
RQ29 Dairy alternatives are healthier			0.617	
RQ21 Fattening			0.615	
RQ28 Mucus			0.412	
Factor 5: Positive perceptions of dairy products.	3.8	0.67		0.666
RQ24 Not needed			0.690	
RQ20 Easy to get calcium			0.612	
Q23 Protein and nutrients			0.630	
Q25 Healthier without			0.579	

Q19 Taste	0.575

Note. Questions that were reverse scored are identified by an R at the front of the item.

Note. The factors are displayed in the order of strength of factor loading for each of the five factors.

Linear Regressions

Linear regressions were performed separately for each of the five factors. The predictor variables included gender (female=1, male=2); race/ethnicity (white=1, non-white=2); college affiliation (College of Agriculture=1, all other colleges=2); dietary pattern (omnivorous diet=1, all other dietary patterns that did not include meat=2); student level in college (early undergraduate (freshman/sophomore)=1, late undergraduate (junior/senior)=2, graduate student=3); population size estimate for the area they were primarily raised (0=unknown, 1=<10,000, 2=10,000–99,000, 3=100,000–999,000, 4=1,000,000 or more); and self-reported high level of agricultural knowledge (1=strongly disagree, 2=somewhat disagree, 3=neither agree nor disagree, 4=somewhat agree, 5=strongly agree). The results of the linear regressions are displayed in table 3.5. The consistent significant predictors of attitudes toward red meat and dairy product consumption across all five factors were college affiliation and dietary pattern. These predictor variables functioned as hypothesized where those who included animal products in their diet (omnivorous dietary pattern) agreed with positive statements about red meat and dairy consumption to a greater extent than those who reported more plant-based dietary patterns (factor 1; 3.8±0.60 vs. 2.8±0.83; $p<0.01$) (factor 2; 3.1±0.81 vs. 2.1±0.65; $p<0.01$) (factor 3; 3.2±0.85 vs. 2.7±0.77; $p<0.01$) (factor 4; 3.3±0.73 vs. 2.5±0.72; $p<0.01$) (factor 5; 3.9±0.63 vs. 3.1±0.0.76; $p<0.01$). Similarly, those who were affiliated with the College of Agriculture as

compared with all other colleges reported more agreement with positive statements about red meat and dairy intake (factor 1; 4.1±0.68 vs. 3.7±0.66; $p<0.01$) (factor 2; 3.6±0.84 vs. 3.0±0.80; $p<0.01$) (factor 3; 3.8±0.94 vs. 3.0±0.78; $p<0.01$) (factor 4; 3.8±0.79 vs. 3.1±0.71; $p<0.01$) (factor 5; 4.1±0.67 vs. 3.8±0.66; $p<0.05$). Race/ethnicity was a significant predictive factor for positive perceptions of red meat (factor 1) and negative perceptions of red meat (factor 2), meaning that non-white participants reported less agreement with positive perceptions of red meat compared to white participants. The size of the population in which participants were primarily raised was also significant in the model for negative perceptions of red meat (factor 2), negative perceptions of toxins, hormones, and antibiotics in red meat (factor 3), and negative perceptions of dairy products (factor 4), meaning that being primarily raised in smaller populations as compared with larger populations was associated with less agreement with positive perceptions of red meat and dairy. Finally, self-reported high levels of agricultural knowledge was significant in the model for positive perceptions of red meat (factor 1) and negative perceptions of toxins, hormones, and antibiotics in red meat (factor 3), indicating that more agreement with having high agricultural knowledge was associated with more positive perceptions of red meat.

Table 3.5 ***Linear Regression for Predictive Values of Student Characteristics***

Predictors	**Positive perceptions of red meat (factor 1)**	**Negative perceptions of red meat (factor 2)**	**Negative perceptions of toxins, hormones, and**	**Negative perceptions of dairy products (factor 4)**	**Positive perceptions of dairy products (factor 5)**

	Standardized β	**Standardized β**	**antibiotics in red meat (factor 3) Standardized β**	**Standardized β**	**Standardized β**
Gender	0.066	0.061	-0.063	0.025	0.071
Race/ethnicity	-0.145**	-0.084*	-0.076	-0.069	-0.025
College Affiliation	-0.138**	-0.241**	-0.266**	-0.256**	-0.107*
Dietary Pattern	-0.374**	-0.262**	-0.126**	-0.221**	-0.285**
Academic level	-0.031	-0.073	0.052	0.030	-0.080
Population Size	-0.069	-0.148**	-0.167**	-0.125**	-0.059

High Agricultural Knowledge	0.100*	0.033	0.096*	0.086	0.060
R^2	0.258	0.208	0.190	0.197	0.136

** $p<0.01$. * $p<0.05$

Chapter 4 - Discussion

The primary aims of this study were to describe the characteristics of the survey respondents and determine the predictive value of student characteristics for attitudes regarding red meat and dairy products as well as their respective plant-based alternatives. The initial descriptive analyses showed that the survey sample was representative of the overall Kansas State University population, as well as most individual college populations (excluding the College of Veterinary Medicine, which was not represented).

Principal component analysis revealed five distinct factors. Three of these factors were related to perceptions of red meat and meat alternatives, while two factors were related to perceptions of dairy and dairy alternatives. The first four factors hung together strongly, as shown by Cronbach's alpha values (table 3.4) that were greater than 0.7, while the fifth factor was not as strong as the first four, with a Cronbach's alpha value that was slightly lower than 0.7. This lower alpha value was also reflected in the difficulty in agreeing on a shared operational definition of the construct measured by the fifth factor. Positive perceptions of red meat (factor 1) included only questions with positive implications for red meat consumption. Negative perceptions of red meat (factor 2), negative perceptions of toxins, hormones, and antibiotics in red meat (factor 3), and negative perceptions of dairy (factor 4) contained only reverse scored questions due to their negative orientation. Positive perceptions of dairy products (factor 5) contained a mix of both positively and negatively oriented (reverse scored) questions. The mix of questions that were positive and negative for animal product consumption may have contributed to the reduced reliability of the fifth factor, however, each of the factor analyses met the criteria for linear regression analyses.

Linear regression analyses revealed that college affiliation and dietary pattern were the only consistent significant predictors for agreement regarding perceptions of red meat and dairy products across all factors. Participants who were affiliated with the College of Agriculture indicated stronger positive perceptions of red meat and dairy compared to students from all other colleges. This conclusion is consistent with the nature of the various majors represented (Animal Sciences and Industry, Feed Science and Management, and Agricultural Education) and coursework options (Meat Science, Dairy and Poultry Science) offered within the College of Agriculture (Animal Science and Industry n.d.; Undergraduate Degrees n.d.). Students who reported eating an omnivorous dietary pattern also reported stronger positive perceptions of red meat and dairy compared to all other dietary patterns. This is consistent with the conclusions from a cross-sectional study where participants who identified themselves as vegetarians were more likely to have negative perceptions of meat and dairy intake, while those who identified themselves as non-vegetarians will have more positive perceptions of meat and dairy intake (Barr & Chapman, 2002). In the current study, participants with higher levels of self-reported agricultural knowledge showed higher levels of agreement with positive perceptions of red meat compared to those with lower levels of self-reported agricultural knowledge. Participants who reported they were primarily raised in more urban populations reported lower levels of agreement with positive perceptions of red meat and dairy compared to those raised in more rural populations. Finally, white students showed higher levels of agreement with positive perceptions of red meat compared to their non-white counterparts.

The questionnaire used in this research was adapted from a previous study that combined both qualitative and quantitative measures and focused on the perceptions of meat and dairy products among women aged 18–50y who were either vegetarian, former vegetarian, or non-

vegetarian (Barr & Chapman, 2002). Although the study sample characteristics were quite different when comparing the two studies, both studies indicated that non-vegetarians had higher levels of agreement with positive statements about meat and dairy (Barr & Chapman, 2002).

There are important limitations to consider when interpreting the findings of this observational, analytical study. The items used in the Qualtrics survey were adapted from a previously validated instrument, however, there is additional work that could be done in the future to improve the survey. Most importantly, creating a survey that asks the same number of questions about each construct and shares the same wording would be an improvement to the survey questions. In the current survey, since only eight of the items contained positively worded language, it became apparent the overall survey had a bias toward negative perceptions of red meat and dairy consumption, which may have affected results and potentially influenced whether or not students responded to the survey. Currently, there are 12 items related to red meat consumption, but only 11 items related to dairy consumption. Making changes to match the wording of each question for both red meat and dairy —for example, using "I like the flavor of red meat" and "I like the flavor of dairy products" instead of "I like the flavor of red meat" and "Dairy products taste good"— would allow for better comparisons between the types of animal products. Additional items related to sustainability aspects of animal products would also be useful given the current popularity and importance of global sustainability. Finally, there were only two questions that discussed red meat and dairy alternatives, so in the future additional questions about this topic should be added to further explore perceptions of plant-based alternatives to animal products. One challenge was determining an appropriate descriptor for each question, as well as for each factor that represented the construct being measured, in particular for the fifth factor. Strengths of this study include that the sample was representative of

the student population at a land-grant university as well as a majority of the individual college populations within the university. As with any cross-sectional study, there are limitations regarding determination of causality and generalizability beyond the sample population. Specifically, the current findings may not apply at a less agricultural or more diverse institution. It is also important to note the possibility of unaccounted for predictive variables, where predictor variables that influence perceptions of red meat, dairy products and their plant-based alternatives are influenced by other unmeasured variables. For example, dietary pattern, a predictor examined in this study, could be influenced by concerns about the environmental implications of consuming red meat and dairy products.

Future research should include other predictors that may be associated with perceptions of red meat, dairy, and plant-based alternatives, such as perceived knowledge or education on plant-based alternatives and historical family dietary patterns. The impact of different dietary patterns on the environment and the importance of prevention of specific health concerns, including mortality and chronic disease risk, would also be beneficial predictors to explore (Aiking, 2014; Sabaté & Soret, 2014; Song et al., 2016; U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). In addition, future research direction should include the development of a more thorough measure of perceptions of plant-based dietary patterns and alternatives, including both taste and health related items. Finally, this study was completed at Kansas State University, which is a land-grant, agriculturally focused institution with a primarily white and omnivorous student population. Therefore, replicating this research at a non-land grant institution that can provide increased diversity in these areas is another important future research direction.

Perceptions of red meat and dairy foods as well as plant-based alternatives among college students have not been thoroughly examined in previous research, and the current study will contribute to better understanding this population of current and future food consumers. High red meat intake has been shown to be associated with increased risk of T2DM, cancer mortality, CVD mortality, and total mortality (Bernstein et al., 2010; Pan et al., 2012; Pan et al., 2011). Additionally, dairy intake has been shown to be associated with increased risk of ovarian cancer, whole milk intake has been shown to be associated with prostate cancer mortality, and high fat dairy intake has been shown to be associated with post-breast cancer mortality (Kroenke et al., 2013; Larsson et al., 2006; Lu et al., 2016). Given these known risks in addition to the importance of the college time period for students, understanding the perceptions of red meat and dairy products among college students can help inform further research and potential dietary interventions for this population. Therefore, gaining knowledge regarding the predictors that impact college students' perceptions of red meat and dairy products lays the groundwork for future research, interventions, and policies in this area.

Chapter 5 - Conclusion

Despite the recent national increase in interest related to plant-based dietary patterns, students at Kansas State University, a land grant university with a strong agricultural history and a student body with relatively homogenous racial populations and dietary patterns, reported generally positive perceptions of red meat and dairy foods. Additionally, participation in dietary patterns that include meat and dairy was quite high among participants, with 91.7% of students surveyed consuming an omnivorous dietary pattern. College affiliation and reported dietary pattern were the most consistent significant variables that predicted agreement with perceptions of red meat and dairy products, with students who consumed an omnivorous dietary pattern indicating significantly more agreement with positive perceptions of red meat and dairy products compared to all other dietary patterns. Similarly, students affiliated with the College of Agriculture indicated significantly more agreement with positive perceptions of red meat and dairy compared to all other colleges. Therefore, the results of this study can be used to tailor education interventions and messaging regarding consumption of red meat, dairy products, and plant-based alternatives to students with differing dietary patterns and educational backgrounds.

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Appendix A - Survey Questionnaire

Perceptions of Meat and Dairy Foods Among College Students

Start of Block: Perceptions of Meat

Q5 I like the flavor of red meat

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q6 Fish and poultry are the best “meat” choices

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q7 Red meat can be part of a healthy diet

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree

- ○ Strongly disagree

Q8 Diets with red meat are healthier than those without

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q9 Eating red meat makes me feel heavy and sluggish

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q10 Red meat contains important nutrients

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q11 Trimmed red meat is as healthful as fish or poultry

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

Q12 There are toxins in animal fat

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

Q13 Red meats have unnatural hormones

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree

Q14 I think red meat has antibiotics

- Strongly agree

- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q15 Red meat is difficult to digest

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q16 I am concerned about the amount of fat in red meat

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q17 Meat alternatives (tofu, legumes, lentils, nuts and seeds, etc) are healthier than red meat.

- ○ Strongly agree
- ○ Somewhat agree

- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

End of Block: Perceptions of Meat

Start of Block: Perceptions of Dairy Foods

Q18 Dairy products cause gas and bloating in most people

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q19 Dairy products taste good

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q20 It is easy to get enough calcium without dairy products

- ○ Strongly agree
- ○ Somewhat agree

- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q21 Dairy products are too fattening to use often

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q22 Diets with dairy are too high in saturated fat and cholesterol

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q23 Dairy products are good sources of protein and nutrients

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree

- ○ Somewhat disagree
- ○ Strongly disagree

Q24 Dairy products are not needed by adults

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q25 A diet with dairy products is healthier than without

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q26 Dairy products contain unnatural hormones

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree

- ○ Strongly disagree

Q27 Dairy products contain antibiotics

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q28 Dairy products give me mucus

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Q29 I think that using fortified dairy alternatives (e.g., soy, almond, rice, etc.) is healthier than using regular dairy products.

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

End of Block: Perceptions of Dairy Foods

Start of Block: Demographic/Background Questions

Q30 What is your age group?

- ○ 18–25y
- ○ 26–30y
- ○ 31–35y
- ○ 36–40y
- ○ >40y

Q31 What Gender do you identify with?

- ○ Male
- ○ Female

Q32 What is your ethnicity?

- ○ American Indian or Native Alaskan
- ○ Asian
- ○ Black or African American
- ○ Native Hawaiian or Other Pacific Islander
- ○ White
- ○ Hispanic
- ○ Other

Q33 What is your academic level in school?

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior
- ○ Master's Level
- ○ PhD Level

Q34 In which college at Kansas State University are your currently enrolled? (If you are enrolled in more than one choose the one you consider to be your primary college)

- ○ College of Human Ecology
- ○ College of Agriculture
- ○ College of Architecture, Planning and Design
- ○ College of Arts and Sciences
- ○ College of Business Administration
- ○ College of Education
- ○ College of Engineering
- ○ College of Veterinary Medicine
- ○ Gerontology
- ○ Other (Please List) _____

Q35 What is your academic department?
For Example: Food, Nutrition, Dietetics and Health (FNDH), Animal Science, etc.
_____

Q36 What is your major?
_____

Q37 What do you consider your dietary eating pattern to be?

- ○ Omnivorous: A diet comprised of both plant and animal products.
- ○ Vegetarian: A diet that excludes meat, fish and fowl, but does include dairy products and eggs.
- ○ Plant-Based: A mainly vegetarian diet, but will sometimes consume meat.
- ○ Vegan: A diet that excludes all animal products (meat, fish, fowl, dairy and eggs) may also exclude gelatin, honey.
- ○ Lacto-Vegetarian: A vegetarian diet that excludes all types of meat and eggs, but still includes dairy products.
- ○ Ovo-Vegetarian: A vegetarian diet that excludes all types of meat and dairy products, but will still include eggs.
- ○ Pescatarian: A vegetarian diet that excludes meat and fowl, but will still include fish.
- ○ Other (Please Specify) _____

Q38 I consider myself to have a high agricultural knowledge.

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree

- ○ Strongly disagree

Q39 Have you ever been involved in an agricultural organization such as FFA or 4-H?

- ○ Yes
- ○ No

Q40 Do you consider the area in which you were primarily raised to be urban or rural?

- ○ Urban
- ○ Rural

Q41 Which of the following best describes the area in which you primarily were raised? If there were multiple locations, please think about the area in which you spent the most time.

- ○ City/town with less than 10,000 people
- ○ City/town with 10,000–99,000 people
- ○ City/town with 100,000–999,000 people
- ○ City/town with 1,000,000 or more people
- ○ Unknown

End of Block: Demographic/Background Questions